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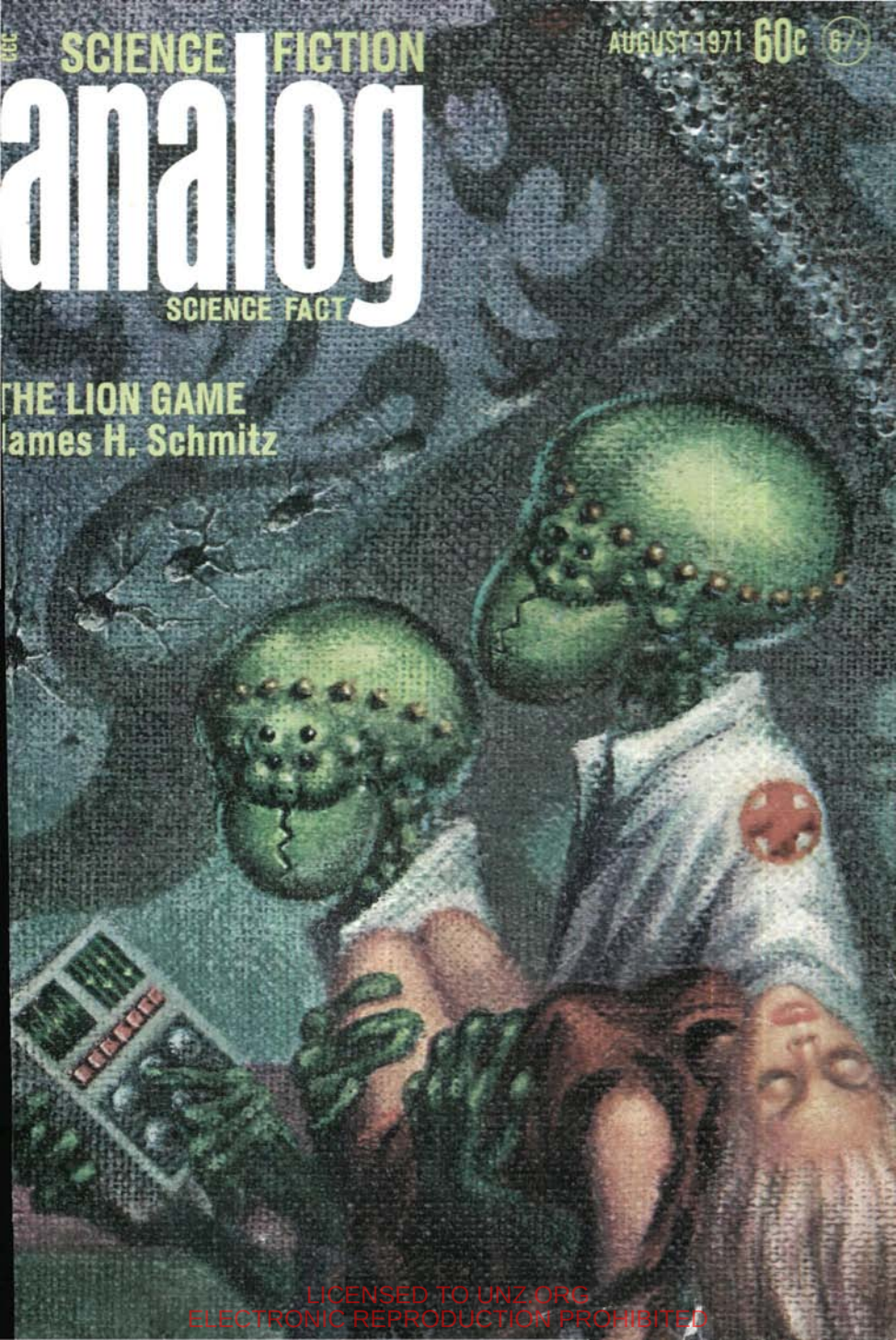
James H. Schmitz



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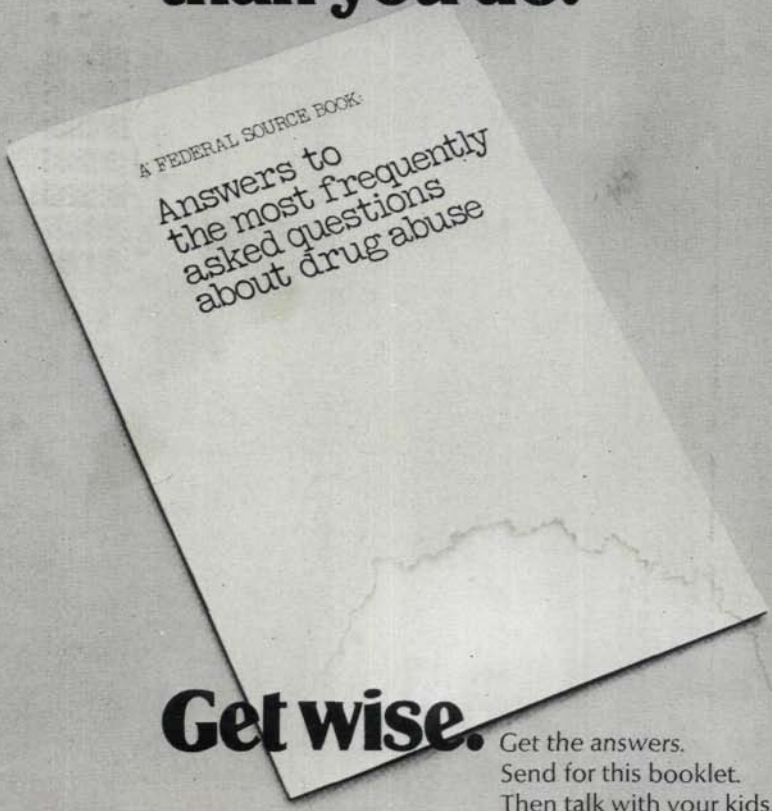

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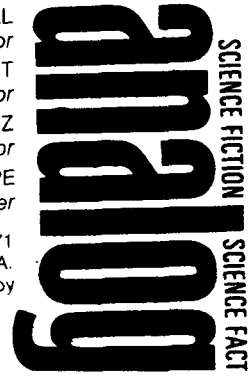

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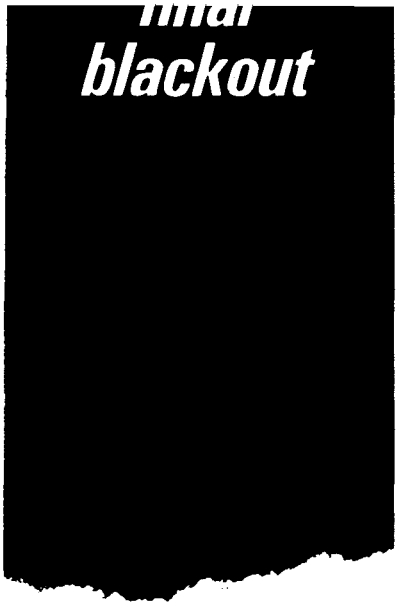

editorial by John W. Campbell

There have been a number of articles on the "black hole" phenomenon in a variety of scientific magazines—from the most erudite supermathematical discussions to the most general popular explanations. As might be expected in dealing with such way-out speculative material, each of the various articles has covered the concepts from a slightly different aspect, considered slightly different consequences, and thus came up with slightly different stories.

In the true sense, each of those discussions in the high-power specialized journals of physics, cosmology and astronomy has been a science-fiction story—each has sought to extrapolate from known data, and currently accepted general theory, what the consequences of extreme conditions would be. Such stories as Hal Clement's "Mission of Gravity" and "Close to Critical" were precisely that sort of science fiction— massive speculation, with a minimum of actual knowledge.

If you haven't yet read one of the articles on the "black hole" phenomenon, the essence is this:

Given a massive star five or more times as massive as Sol, it will consume its nuclear fuel at a much faster rate than Sol. All of its hydrogen will be fused to helium, and the star will then begin to condense under gravitational forces, while the central core temperature goes up into the range of hundreds of millions of degrees. Under these conditions of temperature and pressure, helium itself can be fused to successively heavier elements:

$$2\,He^4 \rightarrow Be^8 + He^4 \rightarrow C^{12} + He^4 \rightarrow O^{16} + He^4 \rightarrow Ne^{20} \ldots$$

This series of additions of He^4 permits the remaining nuclear energy of the "ashes" of hydrogen fusion reactions to be consumed, until the build-up reaches iron. Iron represents the lowest point on the "packing fraction curve"—which expresses the amount of energy per nucleon the nucleus contains, and, therefore, the stability of that nucleus. The nuclei in the region of Fe^{56} are right at

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the bottom of the curve; hydrogen, of course, has the highest energy—that's why it releases so much energy when the protons are combined to helium.

Atoms with nuclei more complex than iron tend to release energy when they come apart—Prime Example No. One being, of course, uranium. Uranium yields energy not by combining to make more complex nuclei, but by fissioning to produce simpler ones.

So our spendthrift star reaches a point where all available nuclear energy has been extracted from its matter—but that force physicists call the "weak" force of gravity, begins to really take over.

A normal star is like an airplane; it's able to defy gravity by a constant application of power. If a plane's engine quits, if it runs out of fuel, it can continue to fly for a while by gliding, by using gravitational energy to keep it moving.

There is, however, a very definite, crunching end to that. Gravitational energy has a tendency to wind up by converting all the remaining energy into light, heat, mechanical distortion, and noise.

Precisely that happens in a star; when it can no longer provide energy output sufficient to "keep flying," to hold its outer layers out by radiation pressure, it falls inward.

When it does that, it appears to be a positive feedback mechanism—and like all positive feedback mechanisms, it goes to completion in an incredible hurry. Once the inner collapse of the star's core starts, the increased density resulting from the partial collapse increases the gravitational intensity, which tends to increase the tendency to collapse. The increased gravitational force causes increased inward acceleration. Which causes greater density faster, which multiplies the collapse-force, which speeds the . . .

Estimates of the time-for-collapse of the stellar core when this sort of thing starts vary; there seems to be general agreement that the *maximum* time required for the collapse of the core of a giant star—several times more massive than our Sun—may be as long as one hundred seconds. Other analyses indicate it may take only slightly longer than the time required for a light-speed pulse to cross the diameter of the stellar core, say one to two seconds.

In any case, immediately after the collapse, there is a neutron star about a dozen miles in diameter where there used to be a 100,000 to 200,000 mile diameter stellar core. And in that instant after the collapse, the temperature of that core material has been driven up to billions of degrees by the release of the stupendous gravitational energy—and there's a fantastic pulse of radiant energy driving outward.

That pulse of energy is violent enough to blast some 80-90% of the star's original mass out into deep space. The explosion is so violent-

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beyond-concepts-of-violence that all the heavy elements much beyond iron are formed during the first few minutes as the outer layers are heated beyond thermonuclear temperatures.

For the next few days, the collapsed star will be throwing off energy faster than the combined total of the energy output of all the other stars in its galaxy. A dozen galaxies away, astronomers will notice a new supernova has bloomed.

In chemistry there's a basic principle that reactions tend to go in the direction which lessens the energy-stress in the system. Thus one volume of nitrogen plus three volumes of hydrogen can combine to form only two volumes of ammonia; the Haber process puts hydrogen and nitrogen under high pressure, which encourages the formation of the desired product since doing so relieves the pressure.

The energy density and violence in an exploding supernova's atmosphere is such that uranium and the transuranic elements form in immense quantities—it represents a reversal of the uranium-fission reaction, and by absorbing the energy of fission, lessens slightly the violence of the supernova environment. In effect, a supernova causes a uranium bomb to *im*plode.

Since no human being can truly appreciate the appalling violence of a fission explosion, the supernova explosion is unimaginably-squared, so to speak.

At the center of this violence, collapsing at the center of the detonation, is the stellar core—which undergoes a number of interesting changes.

Angular momentum is conserved; since the original star was rotating, this collapsed remnant is rotating—but the rate has changed because of the drastic shortening of its radius of gyration. A figure skater builds up spin speed by starting her spin with arms extended, then bringing them in close to her axis of spin, the collapsing stellar core does somewhat the same on an exaggerated scale. The spin-rate increases from the once-a-day-or-so rate of an ordinary star of its class—the Class B and A giants rotate much more rapidly than do the F, G and later classes such as the Sun—to something on the order of 300 to 1,000 *times per second.*

It is now a neutron star, and a pulsar.

The stupendous temperature to which the core material was heated during the collapse produced a variety of effects, to which the now stupendous gravitational force adds some refinements. The surface gravity of something twice as massive as our Sun, with a diameter of 12-15 miles is measured in multimillions of G's. Our best structural materials, under such a gravity, would flow into monomolecular films—assuming they were somehow miraculously protected from the hundreds of millions of degrees of heat.

But strange things happen to mat-

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ter under the conditions of a neutron star; it isn't made up *entirely* of neutrons—for various complex reasons, there are still lots of protons mixed in with the neutrons, so that the material is a superconductor. (We're having trouble getting room-temperature superconductors; neutron stars are superconductors at some 10^8 or 10^9 degrees.) Also, near the surface of the neutron star, the outermost layers crystallize into a solid crust. This is no ordinary solid, naturally; it's hotter than the core of a star like the Sun, yet a crystalline solid. It has a tensile strength and stiffness you can remember as being around a hundred million million million times that of steel, in the neighborhood of 10^{20} times.

Because it had a magnetic field when the star collapsed, and became superconductive, the neutron star is a superconductive magnet—the magnetic field couldn't escape from the superconductive material. But the magnetic field was imploded by the collapse along with the matter it was tied to; the magnetic field of a neutron star is probably the strongest, densest tightest magnetic field in the Universe.

That magnetic field tends to add stiffness to the already fantastic stiffness of the crust of the star.

continued on page 173

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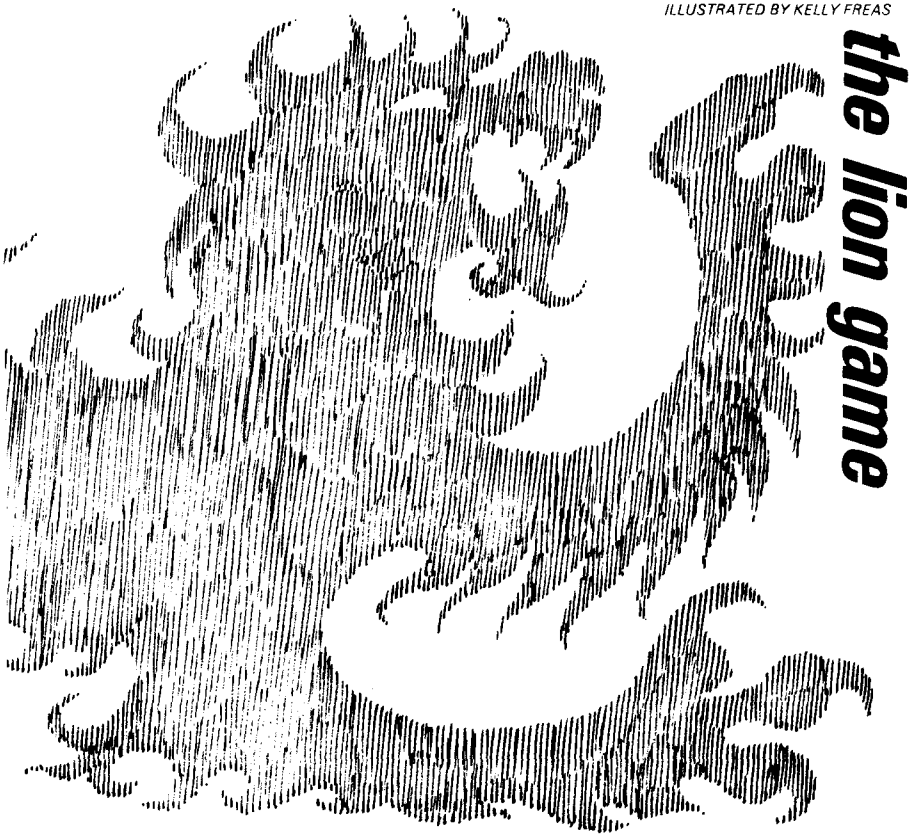
First of Two Parts.
Telzey intended to be bait
to mousetrap some mysterious troublemakers—
but the game turned out not to be mice!

JAMES H. SCHMITZ

ILLUSTRATED BY KELLY FREAS

the lion game



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I

Telzey was about to sit down for a snack in her bungalow before evening classes when the ring she'd worn on her left forefinger for the past week gave her a sting.

It was a fairly emphatic sting. Emphatic enough to have brought her out of a sound sleep if she'd happened to be sleeping. She grimaced, pulled off the ring, rubbed her finger, slipped the ring back on, went to the ComWeb and tapped a button.

Elsewhere on the grounds of Pehanron College several other ComWebs started burring a special signal. One or the other of them would now be switched on, and somebody would listen to what she had to say. She'd become used to that; the realization didn't disturb her.

What she said to her course computer was, "This is Telzey Amberdon. Cancel me for both classes tonight."

The computer acknowledged. Winter rains had been pounding against Pehanron's weather shields throughout the day. Telzey got into boots, long coat and gloves, wrapped a scarf around her head, and went out to the carport at the back of the bungalow. A few minutes later, her car slid out of Pehanron's main gate, switched on its fog beams and arrowed up into a howling storm.

Somebody would be following her through the dark sky. She'd got used to that, too.

She went into a public ComWeb booth not long after leaving the college, and dialed a number. The screen lit up and a face appeared.

"Hello, Klayung," she said. "I got your signal. I'm calling from Beale."

"I know," said Klayung. He was an executive of the Psychology Service, old, stringy, mild-mannered. "Leave the booth, turn left, walk down to the corner. There's a car waiting."

"All right," Telzey said. "Anything else?"

"Not till I see you."

It was raining as hard on Beale as on Pehanron, and this section of the town had no weather shielding. Head bent, Telzey ran down the street to the corner. The door to the back compartment of the big aircar standing there opened as she came up. She slipped inside. The door closed.

Clouds blotted out the lights of Beale below as she was fishing tissues from her purse to dry her face. The big car was a space job though it didn't look like one. She could see the driver silhouetted beyond the partition. They were alone in the car.

She directed a mental tap at the driver, touched a mind shield, standard Psychology Service type. There was no flicker of response or recognition, so he was no psi operator.

Telzey settled back on the seat. Her life had become complicated these weeks. Some secretive psis were taking a hostile interest in her.

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With reason—she might be the first to have escaped alive after a mental encounter with them. She knew they existed, knew at least a few things about them.

She barely *had* escaped alive. They'd sent a savage creature of unknown type after her which traced victims by their mind patterns and teleported to them when they were located. She'd tricked her spooky pursuer into materializing inside a mass of mountain rock, which was destructive to both rock and monster; but she had to expect that when it failed to show up again the psis would start hunting for her. And a careful investigation should turn up sufficient clues to lead them to her in time.

She'd reported her experience immediately to the Psychology Service, which, among other things, handled problems connected with psi and did it quietly to avoid disturbing the public. The Service people went to work on the information she gave them. Unfortunately, she hadn't been able to tell them very much. While she waited for results from that quarter, there was something she could take care of herself, and should take care of at once.

Until now her psi armament had seemed adequate. She'd experimented occasionally with her recently acquired abilities in that field, improving them here and there; but she'd intended to wait until she'd wound up her law studies before giving serious attention to psi and what could be done with it—or, at any rate, to what she could do with it.

That idea had better be dropped! Half a psi talent, it appeared, might turn into a dangerous gift when it attracted the attention of others who didn't stick to halfway measures. She could use an immediate crash course in expanding the talent. The Service might be willing to train her but not necessarily along the lines she wanted. Besides, she preferred not to get too involved with them. But there was a psi she knew, an independent like herself, who should have the experience, if she could get him to share it. Sams Larking wasn't exactly a friend. He was, in fact, untrustworthy, unethical, underhanded and sneaky. The point now, however, was that he was psi-sneaky in a very accomplished manner, and packed a heavy mind clout. Telzey looked him up.

"Why should I help make you any tougher than you are?" Sams inquired.

She explained that Service operators had been giving her too much attention lately. She didn't like the idea of having someone prying around her like that.

Sams grunted. He hated the Psychology Service.

"Been up to something they don't approve of, eh?" he said. "All right. Let's see if we can have a few surprises ready for them next time. You want to be able to spot them without letting them spot you, or send them

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home with lumps—that kind of thing?"

"That kind of thing," Telzey agreed. "I particularly want to be able to work through my own screens. I've noticed you're very good at that. The lumps could be sort of permanent, too!"

Sams looked briefly startled. "Getting rather ferocious, aren't you?" He studied her. "Well, we'll see how much you can handle. It can't be done in an hour or two, you know. Drop in at the ranch early this weekend, and we'll give it a couple of days. The house is psi-blocked, in case somebody comes snooping."

He added, "I'll behave. Word of honor! This will be business—if I can sharpen you up enough, you might be useful to me some day. Get a good night's rest before you come. I'll work you till you're begging to quit."

Work her relentlessly he did. Telzey didn't ask for time out. She was being drilled through techniques it might have taken her months to develop by herself. They discovered she could handle them. Then something went wrong.

She didn't know immediately what it was. She looked over at Sams.

He was smiling, a bit unpleasantly.

"Controlled, aren't you?"

Telzey felt a touch of apprehension. She considered. "Yes," she said, "I am. I must be! But—"

She hesitated. Sams nodded.

"You've been under control for the past half hour. You wouldn't know it now if I hadn't let you know it—and you still don't understand how it's being done, so there's nothing you can do about it, is there?" He grinned suddenly, and Telzey felt the psi controls she hadn't been able to sense till then release her.

"Just a demonstration, this time!" Sams said. "Don't let yourself get caught again. Get a few hours' sleep, and we'll go on. You're a good student."

Around the middle of the second day, he said, "You've done fine! There really isn't much more I can do for you. But now a special gimmick. I never expected to show it to anyone, but let's see if you can work it. It takes plenty of coordination. Screens tight, both sides. You scan. If I spot you, you get jolted so hard your teeth rattle!"

After a few seconds, she said, "I'm there."

Sams nodded.

"Good! I can't tell it. Now I'll leave you an opening, just a flash. You're to try to catch it and slam me at the same instant."

"Well, wait a moment!" Telzey said. "Supposing I don't just try—I *do* it?"

"Don't worry. I'll block. Watch out for the counter!"

Sams's screen opening flicked through her awareness five seconds later. She slammed. But, squeamishly perhaps, she held back somewhat on the bolt.

It took her an hour to bring Sams

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around. He sat up groggily at last.

"How do you feel?" she asked.

He shook his head. "Never mind. Good-bye! Go home. You've graduated. I'm a little sorry for the Service."

Essentially, there were five things she'd been able to tell the Psychology Service about the mystery psis. They were associated with a crime ring and probably controlled it. Then they'd set a retired scientist, who had no conscious awareness of their existence, the task of developing psi machines for them. They used a psi beast to seek out and destroy people who might talk about them. Finally and most importantly perhaps, they might be a mutant strain. Telzey's mental contact with them had been momentary, but she retained impressions of thought forms with a distinct quality she hadn't sensed in human minds before.

A machine copied the impressions from her memory. They were analyzed, checked against Service files. They did have a distinct quality, and it was one which wasn't on record. Special investigators with back-up teams began to scan Orado systematically, trying to tap an incautious mentality which might match the impressions, while local criminal organizations were scrutinized for indications of psi control. Neither approach produced results.

The Service went on giving Orado primary attention but extended its calculations next to the Hub worlds in general. There the sheer size of the Hub's populations made difficulties immense. Psi machines were regarded by many as a coming thing; on a thousand worlds, great numbers of people currently were trying to develop designs which would really work. Another multitude was involved in organized crime. Eccentric forms of murder, including a variety which conceivably could have been carried out by Telzey's psi beast, were hardly uncommon. Against such a background, the secretive psis might remain invisible indefinitely.

"Nevertheless," Klayung, who was in charge of the Service operation, told Telzey, "we may be getting a pattern! It's not too substantial, but it's consistent. If it indicates what it seems to, the people you became involved with are neither a local group nor a small one. In fact, they appear to be distributed rather evenly about the more heavily populated Federation worlds."

She didn't like that. "What kind of pattern is it?"

"Violent death, without witnesses and of recurring specific types—types which could be explained by your teleporting animal. The beast kills but not in obvious beast manner. It remains under restraint. If, for example, it had been able to reach you in Melna Park, it might have broken your neck, dropped you out of your aircar, and vanished. Elsewhere it might have smothered or strangled you, suggesting a human assailant.

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There are a number of variations repetitive enough to be included in the pattern. We're trying to establish connections among the victims. So far we don't have any. You remain our best lead."

Telzey already had concluded that. There were no detectable signs, but she was closely watched, carefully guarded. If another creature like Bozo the Beast should materialize suddenly in her college bungalow while she was alone, it would be dead before it touched her. That was reassuring at present. But it didn't solve the problem.

Evidence that the psis had found her developed within ten days. As Klayung described it, there was now a new kind of awareness of Telzey about Pehanron College, of her coming and going. Not among friends and acquaintances but among people she barely knew by sight, who, between them, were in a good position to tell approximately where she was, what she did, much of the time. Then there was the matter of the ComWebs. No attempt had been made to tamper with the instrument in her bungalow. But a number of other ComWebs responded whenever it was switched on; and her conversations were monitored.

"These people aren't controlled in the ordinary sense," Klayung remarked. "They've been given a very few specific instructions, carry them out, and don't know they're doing it. They have no conscious interest in you. And they haven't been touched in any other way. All have wide-open minds. Somebody presumably scans those minds periodically for information. He hasn't been caught at it. Whoever arranged this is a highly skilled operator. It's an interesting contrast to that first, rather crude, trap prepared for you."

"That one nearly worked," Telzey said thoughtfully. "Nobody's tried to probe me here—I've been waiting for it. They know who I am, and they must be pretty sure I'm the one who did away with Bozo. You think they suspect I'm being watched?"

"I'd suspect it in their place," Klayung said. "They know who you are—not what you are. Possibly a highly talented junior Service operator. We're covered, I think. But I'd smell a trap. We have to assume that whoever is handling the matter on their side also smells a trap."

"Then what's going to happen?"

Klayung shrugged.

"I know it isn't pleasant, Telzey, but it's a waiting game here—unless they make a move. They may not do it. They may simply fade away again."

She made a small grimace. "That's what I'm afraid of!"

"I know. But we're working on other approaches. They've been able to keep out of our way so far. But we're aware of them now—we'll be watching for slips, and sooner or later we'll pick up a line to them."

Sooner or later! She didn't like it at all! She'd become a pawn. A well-protected one—but one with no scrap

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of privacy left, under scrutiny from two directions. She didn't blame Klayung or the Service. For them, this was one problem among very many they had to handle, always short of sufficiently skilled personnel, always trying to recruit any psi of the slightest usable ability who was willing to be recruited. She was one of those who hadn't been willing, not wanting the restrictions it would place on her. She couldn't complain.

But she couldn't accept the situation either. It had to be resolved.

Somehow . . .

II

"What do you know about Tinokti?" Klayung asked.

"Tinokti?" Telzey had been transferred from the car that picked her up in Beale to a small space cruiser standing off Orado. She, Klayung, and the car driver seemed to be the only people aboard. "I haven't been there, and I haven't made a special study of it." She reflected. "Nineteen hours liner time from Orado. Rather dense population. High living standards. World-wide portal circuit system—the most involved in the Federation. A social caste system that's also pretty involved. Government by syndicate—a scientific body, the Tongi Phon. Corrupt, but they have plenty of popular support. As scientists they're supposed to be outstanding in a number of fields. That's it, mainly. Is it enough?"

Klayung nodded. "For now. I'll fill you in. The Tongi Phon's not partial to the Service. They've been working hard at developing a psi technology of their own. They've got further than most, but still not very far. Their approach is much too conservative—paradoxes disturb them. But they've learned enough to be aware of a number of possibilities. That's made them suspicious of us."

"Well, they might have a good deal to hide," Telzey said.

"Definitely. They do what they can to limit our activities. A majority of the commercial and private circuits are psi-blocked, as a result of a carefully underplayed campaign of psi and psi machine scares. The Tongi Phon Institute is blocked, of course; the Phons wear mind shields. Tinokti, in general, presents extraordinary operational difficulties. So it was something of a surprise when we got a request for help today from the Tongi Phon."

"Help in what?" Telzey asked.

"Four high-ranking Phons," Klayung explained, "were found dead together in a locked and guarded vault area at the Institute. Their necks had been broken and the backs of the skulls caved in—in each case apparently by a single violent blow. The bodies showed bruises but no other significant damage."

She said after a moment, "Did the Institute find out anything?"

"Yes. The investigators assumed at first a temporary portal had been set

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up secretly to the vault. But there should have been residual portal energy detectable, and there wasn't. They did establish then that a life form of unknown type had been present at the time of the killings. Estimated body weight close to seven hundred pounds."

Telzey nodded. "That was one of Bozo's relatives, all right!"

"We can assume it. The vault area was psi-blocked. So that's no obstacle to them. The Phons are badly frightened. Political assassinations are no novelty at the Institute, but here all factions lost leading members. Nobody feels safe. They don't know the source of the threat or the reason for it, but they've decided psi may have been involved. Within limits, they're willing to cooperate with the Service."

He added, "As it happens, we'd already been giving Tinokti special attention. It's one of perhaps a dozen Hub worlds where a secret psi organization would find almost ideal conditions. Since they've demonstrated an interest in psi machines, the Institute's intensive work in the area should be a further attraction. Mind shields or not, it wouldn't be surprising to discover the psis have been following that project for some time. So the Service will move to Tinokti in strength. If we can trap a sizable nest, it might be a long step toward rounding up the lot wherever they're hiding."

Klayung regarded Telzey a moment.

"Because of its nature," he remarked, "this isn't technically even a classified operation. It's one that has no official existence. It isn't happening. After it's over with, it won't have happened."

Telzey said, "You've told me because you want me to go to Tinokti?"

"Yes. We should be able to make very good use of you. The fact that you're sensitized to the psi's mind type gives you an advantage over our operators. And your sudden interest in Tinokti after what's occurred might stimulate some reaction from the local group."

"I'll be bait?" Telzey said.

"In part. Our moment to moment tactics will depend on developments, of course."

She nodded. "Well, I'm bait here, and I want them off my neck. What will the arrangement be?"

"You're making the arrangement," Klayung told her. "A psi arrangement, to keep you in character—the junior Service operator who's maintaining her well-established cover as a law student. You'll have Pehanron assign you to a field trip to Tinokti to do a paper on the legalistic aspects of the Tongi Phon government."

"It'll have to be cleared with the Institute," Telzey said.

"We'll take care of that."

"All right." She considered. "I may have to work on three or four minds. When do I leave?"

"A week from today."

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Telzey nodded. "That's no problem then. There's one thing . . ."

"Yes?"

"The psis have been so careful not to give themselves away here. Why should they create an obvious mystery on Tinokti?"

Klayung said, "I'm wondering. There may be something the Phons haven't told us. However, the supposition at present is that the beast failed to follow its instructions exactly—as the creatures may, in fact, have done on other occasions with less revealing results. You had the impression that Bozo wasn't too intelligent."

"Yes, I did," Telzey said. "But it doesn't seem very intelligent either to use an animal like that where something could go seriously wrong, as it certainly might in a place like the Institute. Particularly when they still haven't found out what happened to their other psi beast on Orado."

What were they?

Telzey had fed questions to information centers. Reports about psi mutant strains weren't uncommon, but one had to go a long way back to find something like confirming evidence. She condensed the information she obtained, gave it, combined with her own recent experiences, to Pehanron's probability computer to digest. The machine stated that she was dealing with descendants of the historical mind masters of Nalakia, the Elaigar.

She mentioned it to Klayung. He wasn't surprised. The Service's probability computers concurred.

"But that's impossible!" Telzey said, startled. The information centers had provided her with a great deal of material on the Elaigar. "If the records are right, they averaged out at more than five hundred pounds. Besides, they looked like ogres! How could someone like that be moving around in a Hub city without being noticed?"

Klayung said they wouldn't necessarily have to let themselves be seen, at least not by people who could talk about them. If they'd returned to the Hub from some other galactic section, they might have set up bases on unused nonoxygen worlds a few hours from their points of operation, almost safe from detection so long as their presence wasn't suspected. He wasn't discounting the possibility.

Telzey, going over the material again later, found that she didn't much care for the possibility. The Elaigar belonged to the Hub's early colonial period. They'd been physical giants with psi minds, a biostructure believed to be of human origin, developed by a science-based cult called the Grisands, which had moved out from the Old Territory not long before and established itself in a stronghold on Nalakia. In the Grisand idiom, Elaigar meant the Lion People. It suggested what the Grisands intended to achieve—a controlled formidable strain through which they could dominate the other

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humans on Nalakia and on neighboring colony worlds. But they lost command of their creation. The Elaigar turned on them, and the Grisands died in the ruins of their stronghold. Then the Elaigar set out on conquests of their own.

Apparently they'd been the terrors of that area of space for a number of years, taking over one colony after another. The humans they met and didn't kill were mentally enslaved and thereafter lived to serve them. Eventually, war fleets were assembled in other parts of the Hub; and the prowess of the Elaigar proved to be no match for superior space firepower. The survivors among them fled in ships crewed by their slaves and hadn't been heard from again.

Visual reproductions of a few of the slain mutants were included in the data Telzey had gathered. There hadn't been many available. The Hub's War Centuries lay between that time and her own; most of the colonial period's records had been destroyed or lost. Even dead and seen in the faded recordings, the Elaigar appeared as alarming as their reputation had been. There were a variety of giant strains in the Hub, but most of them looked reasonably human. The Elaigar seemed a different species. The massive bodies were like those of powerful animals, and the broad hairless faces brought to mind the faces of great cats.

But human the prototype must have been, Telzey thought—if it *was* Elaigar she'd met briefly on the psi level in Orado's Melna Park. The basic human mental patterns were discernible in the thought forms she'd registered. What was different might fit these images of the Nalakian mind masters and their brief, bloody Hub history. Klayung could be right.

"Well, just be sure," Jessamine Amberdon commented when Telzey informed her parents by ComWeb one evening that she'd be off on a field assignment to Tinokti next day, "that you're back ten days from now."

"Why?" asked Telzey.

"For the celebration, of course."

"Eh?"

Jessamine sighed. "Oh, Telzey! You've become the most absent-minded dear lately! That's your birthday, remember? You'll be sixteen."

III

Citizens of Tinokti tended to regard the megacities of other Federation worlds as overgrown primitive villages. They, or some seventy percent of them, lived and worked in the enclosed portal systems called circuits. For most it was a comfortable existence; for many a luxurious one.

A portal, for practical purposes, was two points in space clamped together to form one. It was a method of moving in a step from here to there, within a limited but consid-

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erable range. Portal circuits could be found on many Hub worlds. On Tinokti they were everywhere. Varying widely in extent and complexity, serving many purposes, they formed the framework of the planet's culture.

On disembarking at the spaceport, Telzey had checked in at a great commercial circuit called the Luerral Hotel. It had been selected for her because it was free of the psi blocks in rather general use here otherwise. The Luerral catered to the interstellar trade; and the force patterns which created the blocks were likely to give people unaccustomed to them a mildly oppressive feeling of being enclosed. For Telzey's purpose, of course, they were more serious obstacles.

While registering, she was equipped with a guest key. The Luerral Hotel was exclusive; its portals passed only those who carried a Luerral key or were in the immediate company of somebody who did. The keys were accessories of the Luerral's central computer and on request gave verbal directions and other information. The one Telzey selected had the form of a slender ring. She let it guide her to her room, found her luggage had preceded her there, and made a call to the Tongi Phon Institute. Tinokti ran on Institute time; the official workday wouldn't begin for another three hours. But she was connected with someone who knew of her application to do legal research, and was told a guide would come to take her to the Institute when it opened.

She set out then on a stroll about the hotel and circled Tinokti twice in an hour's unhurried walk, passing through portals which might open on shopping malls, tropical parks or snowy mountain resorts, as the circuit dipped in and out of the more attractive parts of the planet. She was already at work for Klayung, playing the role of a psi operator who was playing the role of an innocent student tourist. She wore a tracer which pinpointed her for a net of spacecraft deployed about the planet. The bracelet on her left wrist was a Service communicator; and she was in wispy but uninterrupted mind contact with a Service telepath whose specialty it was to keep such contacts undetectable for other minds. She also had armed company unobtrusively preceding and following her. They were probing Tinokti carefully in many ways; she was now one of the probes.

Her thoughts searched through each circuit section and the open areas surrounding it as she moved along. She picked up no conscious impressions of the Service's quarry. But twice during that hour's walk, the screens enclosing her mind like a flexing bubble tightened abruptly into a solid shield. Her automatic detectors, more sensitive than conscious probes, had responded to a passing touch of the type of mental patterns they'd been designed to warn her against. The psis were

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here—and evidently less cautious than they'd been on Orado after her first encounter with them.

When she'd come back to the hotel's Great Lobby, Gudast, her Service contact, inquired mentally, "Mind doing a little more walking?"

Telzey checked her watch. "Just so I'm not late for the Phons."

"We'll get you back in time."

"All right. Where do I go?"

Gudast said, "Those mind touches you reported came at points where the Luerral Hotel passes through major city complexes. We'd like you to go back to them, leave the circuit and see if you can pick up something outside."

She got short-cut directions from the Luerral computer, set out again. The larger sections had assorted transportation aids, but, on the whole, circuit dwellers seemed to do a healthy amount of walking. Almost all of the traffic she saw was pedestrian.

She took an exit presently, found herself in one of the city complexes mentioned by Gudast. Her Luerral ring key informed her the hotel had turned her over to the guidance of an area computer and that the key remained at her service if she needed information. Directed by Gudast, she took a seat on a slideway, let it carry her along a main street. Superficially, the appearance of things here was not unlike that of some large city on Orado. The differences were functional. Psi blocks were all about, sensed as a gradually shifting pattern of barriers to probes as the slideway moved on with her. Probably less than a fifth of the space of the great buildings was locally open; everything else was taken up by circuit sections connected to other points of the planet, ranging in size from a few residential or storage rooms to several building levels. Milkily gleaming horizontal streaks along the sides of the buildings showed that many of the sections were protected by force fields. Tinokti's citizens placed a high value on privacy.

Telzey stiffened suddenly. "Defense reaction!" she told Gudast.

"Caught it," his thought whispered.

"It's continuing." She passed her tongue over her lips.

"See a good place to get off the slideway?"

Telzey glanced along the street, stood up. "Yes! Big display windows just ahead. Quite a few people."

"Sounds right."

She stepped off the slideway as it came up to the window fronts, walked over, started along the gleaming windows, then stopped, looking in at the displayed merchandise. "I'm there," she told Gudast. "Reaction stopped a moment ago."

"See what you can do. We're set up."

Her psi sensors reached out. She brought up the thought patterns she'd recorded in Melna Park and stored in memory, blurred them,

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projected them briefly—something carelessly let slip from an otherwise guarded mind. She waited.

Her screens tried to tighten again. She kept them as they were, overriding the automatic reaction. Then something moved faintly into awareness—mind behind shielding, alert, questioning, perhaps suspicious. Still barely discernible.

"Easy . . . easy!" whispered Gudast. "I'm getting it. We're getting it. Don't push at all! Give us fifteen seconds . . . ten—"

Psi block!

The impression had vanished.

Somewhere the being producing it had moved into a psi-blocked section of this city complex. Perhaps deliberately, choosing mental concealment. Perhaps simply because that was where it happened to be going when its attention was caught for a moment by Telzey's broadcast pattern. The impression hadn't been sufficiently strong to say anything about it except that this had been a mind of the type Telzey had encountered on Orado. They'd all caught for an instant the specific qualities she'd recorded.

The instant hadn't been enough. Klayung had brought a number of living psi compasses to Tinokti—operators who could have pinpointed the position of the body housing that elusive mentality, given a few more seconds in which to work.

They hadn't been given those seconds, and the mentality wasn't contacted again. Telzey went on presently to the other place where she'd sensed a sudden warning, and prowled about here and there outside the Luerral Circuit, while Klayung's pack waited for renewed indications. This time they drew a blank.

But it had been confirmed that the psis—some of them—were on Tinokti.

The problem would be how to dig them out of the planet-wide maze of force-screened and psi-blocked circuit sections.

Telzey's Institute guide, a young man named Phon Hajugan, appeared punctually with the beginning of Tinokti's workday. He informed Telzey he held the lowest Tongi Phon rank. The lower echelons evidently hadn't been informed of the recent killings in the Institute vault and their superiors' apprehensions—Phon Hajugan was in a cheery and talkative mood. Telzey's probe disclosed that he was equipped with a chemical mind shield.

There was no portal connection between the Luerral Hotel's circuit and that of the Institute. Telzey and her guide walked along a block of what appeared to be a sizable residential town before reaching an entry portal of the Tongi Phon Circuit, where she was provided with another portal key. She'd been making note of the route; in future she didn't intend to be distracted by the presence of a guide. The office to which Phon

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Hajugan conducted her was that of a senior Phon named Trondbarg. It was clear that Phon Trondbarg did know what was going on. He discussed Telzey's Pehanron project in polite detail but with an air of nervous detachment. It had been indicated to the Institute that she was a special agent of the Service, and that her research here was for form's sake only.

The interview didn't take long. Her credentials would be processed, and she was to return in four hours. She would have access then to normally restricted materials and be able to obtain other information as required. In effect, she was being given a nearly free run of the Institute, which was the purpose. Unless there were other developments, much of the Service's immediate attention would be focused on the areas and personnel associated with the Tongi Phon's psi technology projects. The Phon leadership didn't like it but had no choice. They would have liked it less if they'd suspected that mind shields now would start coming quietly undone. The Service wanted to find out who around here was controlled and in what manner.

Some form of counteraction by the concealed opposition might be expected. Preparations were being made for it, and Telzey's personal warning system was one part of the preparations.

She returned to the Luerral Circuit and her hotel room alone except for her unnoticeable Service escorts, spent the next two hours asleep to get herself shifted over to the local time system, then dressed in a Tinokti fashion item, a sky-blue belted jacket of military cut and matching skirt, and had a belated breakfast in a stratosphere restaurant of the hotel. Back in the Great Lobby, she began to retrace the route to the Tongi Phon Institute she'd followed with Phon Hajugan some five hours ago. A series of drop shafts took her to a scenic link with swift-moving slideways; then there was a three-portal shift to the southern hemisphere where the Institute's major structures were located. She moved on through changing patterns of human traffic until she reached the ninth portal from the Great Lobby. On the far side of that portal, she stopped with a catch in her breath, spun about, found herself looking at a blank wall, and turned again.

Her mental contact with Gudast was gone. The portal had shifted her into a big, long, high-ceilinged room, empty and silent. She hadn't passed through any such room with Phon Hajugan. She should have exited here instead into the main passage of a shopping center.

She touched the wall through which she'd stepped an instant ago—as solid now as it looked. A one-way portal. The room held the peculiar air of blankness, a cave of stillness about the mind, which said it was psi-blocked and that the blocking fields were close by. Watching a

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large closed door at the other end of the room, Telzey clicked on the bracelet communicator. No response from the Service . . . No response either, a moment later, from the Luerral ring key!

She'd heard that in the complexities of major portal systems, it could happen that a shift became temporarily distorted and one emerged somewhere else than one had intended to go. But that hadn't happened here. There'd been people directly ahead of her, others not many yards behind, her Service escorts among them, and no one else had portaled into this big room which was no part of the Luerral Circuit.

So it must be a trap—and a trap set up specifically for her along her route from the hotel room to the Tongi Phon Institute. As she reached the portal some observer had tripped the mechanisms which flicked in another exit for the instant needed to bring her to the room. If the Service still had a fix on the tracking device they'd given her, they would have recognized what had happened and be zeroing in on her now, but she had an unpleasantly strong conviction that whoever had cut her off so effectively from psi and communicator contacts also had considered the possibility of a tracking device and made sure it wouldn't act as one here.

The room remained quiet. A strip of window just below the ceiling ran along the wall on her left, showing patches of blue sky and tree greenery outside. It was far out of her reach, and if she found something that let her climb up to it, there was no reason to think it would be possible to get through that window. But she started cautiously forward. The room was ell-shaped; on her right, the wall extended not much more than two thirds of its length before it cornered.

She could sense nothing but yet someone could be waiting behind the corner for her until she got there. No one was. That part of the room was as bare as the other. At the end of it was a second closed door, a smaller one.

She turned back toward the first door, checked, skin crawling. Mind screens had contracted abruptly into a hard shield. One of *them* had come into this psi-blocked structure.

One or more of them . . .

The larger door opened seconds later. Three tall people came into the room.

IV

Telzey's continuing automatic reaction told her the three were psis of the type she'd conditioned herself to detect and recognize. Whatever they were, they had nothing resembling the bulk and massive structure of the Elaigar mind masters she'd studied in the old Nalakian records. They might be nearly as tall. The smallest, in the rich blue cloak and hood of a Sparan woman, must measure at

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least seven feet, and came barely up to the shoulders of her companions who wore the corresponding gray cloaks of Sparan men. Veils, golden for the woman, white for the men, concealed their faces below the eyes and fell to their chests.

But, of course, they weren't Sparans. Telzey had looked into Sparan minds. They probably were the Hub's most widespread giant strain, should have the average sprinkling of psi ability. They weren't an organization of psis. Their familiar standardized dressing practices simply provided these three with an effective form of concealment.

Telzey, heart racing, smiled.

"I hope I'm not trespassing!" she told them. "I was in the Luerral Hotel just a minute ago and have no idea how I got here! Can you tell me how to get back?"

The woman said in an impersonal voice, "I'm sure you're quite aware you're not here by accident. We'll take you presently to some people who want to see you. Now stand still while I search you."

She'd come up as she spoke, removing her golden gloves. Telzey stood still. The men had turned to the left along the wall, and a recess was suddenly in sight there . . . some portal arrangement. The recess seemed to be a large, half-filled storage closet. The men began bringing items out of it, while the woman searched Telzey quickly. The communicator and the Service's tracking device disappeared under the blue cloak. The woman took nothing else. She straightened again, said, "Stay where you are," and turned to join her companions who now were packing selected pieces of equipment into two carrier cases they'd taken from the closet. They worked methodically but with some haste, occasionally exchanging a few words in a language Telzey didn't know. Finally they snapped the cases shut, began to remove their Sparan veils and cloaks.

Telzey watched them warily. Her first sight of their faces was jarring. They were strong handsome faces with a breed similarity between them. But there was more than a suggestion there of the cruel cat masks of Nalakia. They'd needed the cover of the Sparan veil to avoid drawing attention to themselves.

The bodies were as distinctive. The woman, now in trunks, boots and short-sleeved shirt, as were the men, a gun belt fastened about her, looked slender with her height and length of limb, but layers of well-defined muscle shifted along her arms and legs as she moved. Her neck was a round strong column, the sloping shoulders correspondingly heavy, and there was a great depth of rib cage, drawing in sharply to the flat waist. She differed from the human standard as a strain of animals bred for speed or fighting might differ from other strains of the same species. Her companions were male counterparts, larger, more heavily muscled.

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There'd been no trace of a mental or emotional impression from any of them; they were closely screened. The door at the end of the room opened now, and a third man of the same type came in. He was dressed almost as the others were, but everything he wore was dark green; and instead of a gun, a broad knife swung in its scabbard from his belt. He glanced at Telzey, said something in their language. The woman looked over at Telzey.

"Who are you?" Telzey asked her.

The woman said, "My name is Kolki Ming. I'm afraid there's no time for questions. We have work to do." She indicated the third man. "Tscharen will be in charge of you at present."

"We'll leave now," Tscharen told Telzey.

They were in a portal circuit. Once out of the room where Telzey had been trapped, they used no more doors. The portal sections through which they passed were small ones, dingy by contrast with the Luerral's luxuries, windowless interiors where people once had lived. Lighting and other automatic equipment still functioned; furnishings stood about. But there was a general air of long disuse. Psi blocks tangibly enclosed each section.

The portals weren't marked in any way, but Tscharen moved on without hesitation. They'd reach a wall and the wall would seem to dissolve about and before them; and they'd be through it, somewhere else—a somewhere else which didn't look very different from the section they'd just left. After the sixth portal shift, Tscharen turned into a room and unlocked and opened a wall cabinet.

A viewscreen had been installed in the cabinet. He manipulated the settings, and a brightly lit and richly furnished area, which might have been the reception room of some great house, appeared in the screen. There was no one in sight; the screen was silent. Tscharen studied the room for perhaps a minute, then switched off the screen, closed and locked the cabinet, motioned to Telzey and turned to leave. She followed.

They passed through two more portals. The second one took them into the big room of the viewscreen. They'd moved on a few steps across thick carpeting when Tscharen whirled abruptly. Telzey had a glimpse of a gun in his hand, saw him drop sideways. Someone landed with a harsh yell on the floor behind her, and a great hand gripped the back of her jacket below the collar. For a moment, a face stared down into hers. Then she was tossed aside with careless violence, and when she looked up from the carpeting, the giants were coming in through a doorspace at the far end of the room.

They moved like swift animals. She had barely time to scramble to her feet before they were there. One of them caught her arm, held her in

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a rock-hard grip, but the immediate attention of the group was on Tscharen. They crouched about him, shifting quickly back and forth. He'd recovered from whatever had knocked him out, was struggling violently. There were short angry shouts. Gusts of savage emotion boiled up, a battering of psi energies. Telzey's gaze flicked to the wall through which they'd stepped. Grips were fastened to it above the point where the portal had opened briefly. That was where Tscharen's attacker had clung, waiting. So these others had known he was coming along that route, or that someone was coming, and had laid an ambush.

The psi tumult ebbed out. They began to separate, get to their feet. She saw Tscharen lying face down, hands fastened behind his back, trussed up generally and motionless. Two remained beside him. The others turned toward Telzey, spreading out in a semicircle.

She swallowed carefully. More than a dozen stared at her, faces showing little expression at the moment. They were dressed in the same sort of dark green outfit as Tscharen, belted with guns and knives. The majority were of his type. Two of them, slighter, smaller-boned, were females.

But four in the group were not at all of the same type. They stood not many inches taller than the rest but were much more hugely designed throughout. They were, in fact, unmistakably what the old records had told about and shown—the psi ogres of Nalakia, the Elaigar.

One of these rumbled something to the lesser giant holding Telzey's arm. Thought patterns flickered for a moment through her awareness. She had the impression they didn't quite know what to make of the fact that she'd been in Tscharen's company.

She glanced toward the ogre who'd spoken. His brooding eyes narrowed. A mind probe stabbed at her.

Her shield blocked it.

Interest flared in the broad face. The others stirred, went quiet again.

So now they knew she was a psi.

Another probe came from the Elaigar, heavy and hard, testing the shield in earnest. It held. Some of the others began to grin. He grunted, in annoyance now, returned with a ramming thrust. Telzey slammed a bolt back at him, struck heavy shielding, and his eyes went wide with surprise. There was a roar of laughter. As psi mentalities, the great Elaigar seemed the same as Tscharen's kind; she could make out no difference between them.

The noise ended abruptly. Faces turned toward the doorspace and the group shifted position, hands moving toward guns and knife hilts. Telzey followed their gaze. Hot fright jolted through her.

An animal stood in the room thirty feet away, small red eyes fixed on her. Thick-bodied, with massive head and forelimbs—one of their teleporting killers. It didn't move,

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but its appearance and stare were infinitely menacing. The giants themselves clearly weren't at ease in its presence.

It vanished.

Simultaneously, a voice spoke harshly from the doorway and another huge Elaigar strode into the room, followed by a humanoid creature in green uniform. It was a moment before Telzey realized the newcomer was female. There was little to distinguish her physically from the males of her type here. But something did distinguish her—something like a blaze of furious energy which enlivened the brutal features in their frame of shaggy black hair. Through her shield, Telzey felt a powerful mind sweep toward her, then abruptly withdraw. The giantess glanced at her as she approached, said something to the attendant humanoid, then turned toward Tscharen and addressed the others in a hard deep voice. The attitude of the group indicated she held authority among them.

The humanoid stopped before Telzey, took an instrument from one of his uniform pockets, thumbed open the cover, held the instrument to his mouth, pronounced a few high-pitched sentences, closed the device and replaced it. He looked up at the giant holding Telzey by the arm, and the giant growled a few words and moved off. The humanoid looked at Telzey. She looked at him.

Except for the fact that he wasn't much taller than she, his appearance was no more reassuring than that of the giants. The large round head and the hands were covered by skin like plum-colored velvet. The two eyes set wide apart in the head were white circles with black dots as pupils. There were no indications of ears, nostrils, or other sense organs. The mouth was a long straight lipless line. A variety of weapons and less readily definable devices were attached to the broad belt about the flat body.

The creature unclipped two of the belt gadgets now, stepped up to Telzey and began running them over her clothes. She realized she was being searched again and stood still. Plum-face was methodical and thorough. Everything he found he looked over briefly and stuffed into one of his pockets, winding up by pulling the Luerral ring key from Telzey's finger and adding it to the other items. Then he returned the search devices to his belt and spoke to somebody who was now standing behind Telzey. The somebody moved around into view.

Another kind of alien. This one was also about Telzey's size, wore clothing, walked upright on two legs. Any physical resemblance to humanity ended there. It had a head like that of a soft-shelled green bug, jaws hinged side to side. A curved band of yellow circles across the upper part of the face seemed to be eyes. What was visible of arms and

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legs, ending in bony hands and narrow shod feet, was reedy and knob-jointed, the same shade of green as the head.

This creature didn't look at Telzey but simply stood there. Telzey guessed Plum-face had summoned it to the room with his communicator. Two of the group had picked up Tscharen now and were carrying him from the room. The giantess snapped out some command. The rest started toward the doorspace. She watched them leave, then turned abruptly. Telzey felt a thrill of alarm as the monster came up. The Elaigar spoke, a few short words.

The green alien at once told Telzey softly, in perfect translingue, "You are in the presence of Stiltik, who is a High Commander of the Elaigar. I'm to translate her instructions to you—and I advise you most urgently to do whatever she says, with no hesitation."

The jaws hadn't moved, but a short tube protruded from the front of the stalklike neck. The voice had come from there. The end of the tube was split, forming flexible lips with a fleshy blue tongue tip between them.

The harsh voice of Stiltik, High Commander of the Elaigar, broke in. The green alien resumed quickly. "You must open your mind to Stiltik. Do it immediately!"

But that was the last thing she should do. Telzey said unsteadily, "Open my mind? I don't know what she means."

Bug-face translated. Stiltik, eyes fixed hard on Telzey, growled a brief response. The green creature, seeming almost in distress, said, "Stiltik says you're lying. Please don't defy her! She's very quick to anger."

Telzey just shook her head helplessly.

"But it's impossible! I—"

She broke off. This time, Stiltik hadn't waited for translation. Psi pressure clamped about Telzey's shield, tightened like a great fist. She gave a startled gasp. There was no need to pretend being frightened; she was afraid enough of Stiltik. But not of this form of attack. Her shield had stood up under the crushing onslaught of a great psi machine. As far as she knew, no living mind could produce similar forces.

And in not too many seconds, Stiltik appeared to understand she would accomplish nothing in that manner. The pressure ended abruptly. She stared down at Telzey, made a snorting sound, leaned forward. The mouth smiled in murderous anger; and the huge hands reached out with blurring speed, gripped Telzey, went knowingly to work.

Telzey was reminded in an instant then that when pain is excruciating enough there is no outcry, because lungs and throat seem paralyzed. She could have blocked out most of it, but Stiltik might be in a killing fury, and pain now offered a means of escape. It flowed through her like bursts of fire leaping up and com-

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bining. Her mind dimmed in shock, and she found herself lying on the floor, shaking, shield tight-locked. Stiltik roared out something high above her. Then there were footsteps, moving off. Then darkness, rolling in.

V

She decided presently that she hadn't been unconscious very long, though she hurt a great deal less than she'd expected to be hurting when she woke up. She kept her eyes shut; she wasn't alone. She was lying on her side, with something like a hard cot underneath. The area was psi-blocked, and evidently it was a large structure because she had no feeling of blocking fields close by. Her warning mechanisms indicated one or more minds of the Elaigar type around.

Something touched her lightly in an area which was still sufficiently painful. Around the touch pain began to diminish, as if a slow wave of coolness were spreading out and absorbing it. So she was being treated for the mauling she'd had from Stiltik—very effectively treated, to judge by the way she felt.

Now to determine who was in the vicinity.

Telzey canceled the alerting mechanisms, lightened her shielding, reached out cautiously. After a minute or two, vague thought configurations touched her awareness. Nonpsi and alien they were—she could develop that contact readily.

Next, sense of a psi shield. Whoever used it wasn't far away. . . .

The device which had been draining pain from her withdrew, leaving a barely noticeable residual discomfort where it had been. It touched another sore spot, resumed its ministrations. A mingling of the alien thoughts accompanied the transfer. They were beginning to seem comprehensible—a language half understood. The xenotelepathic quality of her mind was at work.

Her screens abruptly drew tight. There'd been a momentary wash of Elaigar thought. Gone now. But—

Fury swirled about her, surging from a telepathic mind which seemed completely unshielded, nakedly open. An Elaigar mind. The rage, whatever caused it, had nothing to do with Telzey. The giant didn't appear aware that she was in the area.

The impression faded again, didn't return. Telzey waited a minute, slid a light probe toward the psi shield she'd touched. She picked up no indication of anything there. It was a good tight shield, and that was all. Psi shield installed over a nonpsi mind? It should be that.

She left a watch thought there, a trace of awareness. If the shield opened or softened, she'd know, be back for a further look. She returned to the alien nonpsi thought patterns. By now, it was obvious that they were being produced by two minds of the same species.

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It was a gentle, unsuspicious species. Telzey moved easily into both minds. One was Stiltik's green-bug interpreter, named Couse; a female. Couse's race called themselves the Tanvens. Her companion was Sasar, male; a physician. Kind Bug-faces! They had problems enough of their own, no happy future ahead. But at the moment, they were feeling sorry for the human who had been mishandled by Stiltik and were doing what they could to help her.

They might help more than they realized. Telzey put taps on their memory banks which would feed general information to hers without further attention, began dropping specific questions into the nonresisting awarenesses.

Responses came automatically.

After she lost consciousness, she'd been brought here by Essu. Essu was Plum-face, the uniformed humanoid. He was a Tolant, chief of Stiltik's company of Tolants. Stiltik had ordered Couse to summon Sasar, the most skilled physician in her command, to tend to the human's injuries and revive her. She was a valuable captive who was to remain in Essu's charge then, until Stiltik sent for her. The Tanvens didn't know when that would be. But it might be a considerable while, because Stiltik was interrogating the other captive now.

Essu was waiting in the passage outside this room. So he was the wearer of the psi shield, though the Tanvens knew nothing of that. Stiltik presumably had equipped him with one to safeguard her secrets from other psi minds. Essu acted as her general assistant, frequently as her executioner and torturer. A cruel, cunning creature! The Tanvens feared him almost as much as they feared Stiltik.

They didn't know there was an Elaigar in the vicinity. As far as they were aware, they were alone in this circuit section with Essu and Telzey. It had been a hospital facility once, but was now rarely used. The bad-tempered giant might be a good distance away from them.

Telzey shifted her line of questioning. The Elaigar had enslaved members of many races besides Tanvens and Tolants. Giants of Stiltik's kind were called Sattarams and supplied almost all the leaders. The lesser Elaigar were Otessans. Tscharen belonged to a third variety called Alattas, who looked like Otessans and now and then were caught masquerading as them, as Tscharen had been. The Alattas were enemies of the Sattarams and Otessans, and Couse and Sasar had heard rumors that an Alatta force was at present trying to invade the circuit.

At that point, Telzey drew back from the Tanven minds, leaving only the memory taps in place. For immediate practical purposes, Couse and Sasar had a limited usefulness. They were unable to think about the Elaigar in any real detail. When she tried to pin them down, their thought sim-

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ply blurred. They knew only as much about their masters as they needed to know to perform their duties.

Similarly, they had a frustratingly vague picture of the portal circuit the Elaigar had occupied on Tinokti. It appeared to be an extensive system. They were familiar with a limited part of it and had been supplied with key packs which permitted them to move about within that area. They had no curiosity about what lay beyond. In particular, they'd never wondered about the location of exits from the circuit to the world outside. Escape was something they didn't think about; it was a meaningless concept. The Elaigar had done a thorough job of conditioning them.

She could control the Tanvens easily, but it wouldn't gain her anything.

Plum-face was the logical one to get under control. He was in charge of her, and the fact that he was Stiltik's assistant could make him the most useful sort of confederate. However, the psi shield presented a problem. Telzey thought she could work through it, given time enough. But Stiltik might show up and discover what she was doing. Stiltik would make very sure then that she didn't get a chance to try other tricks.

She decided to wait a little with Essu. The shield might be less inflexible than it seemed at present. Meanwhile, there was a fourth mind around. The Elaigar mind.

She considered, not liking that notion too well. There'd been occasional impressions which indicated this particular Elaigar remained careless about his shielding. He didn't seem to be aware of any of them here. But if he suspected he was being probed, he'd start hunting around the limited psi-blocked area for the prober.

She thought finally she should take the chance—he was preoccupied and angry.

She reached out gradually toward the Elaigar awareness. Her concern lessened then. There was a screen there but so loosely held it might as well have been nonexistent. The thought currents behind it shifted in fluctuating disorder over a quivering undercurrent of anger. Insane, she realized. A sick old male sunk deep in derangement, staring at problems for which there was no real solution, rousing himself periodically to futile fury.

Telzey eased in a memory tap, paused—

Stiltik! She slipped out of the Elaigar mind, flicked her watch thought away from Essu's shield. Tight went her own shield then.

Stiltik was present, after a fashion. Somewhere in this psi-blocked structure, a portal had opened and she'd stepped through. A signal now touched Essu's shield, and the shield went soft. Not many seconds later, it hardened again. Some instruction had been given the Tolant.

But Stiltik wasn't yet gone. Telzey

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sensed a search thought about. She could hide from it by ceasing all psi activity, but that simply would tell Stiltik she was conscious. She allowed a normal trickle of psi energy to drift out; let Stiltik's mind find her behind her shield.

Something touched the shield, tested it with a slow pressure probe, which got nowhere, withdrew. A hard, dizzying bolt slammed suddenly at her then; another. That sort of thing shouldn't help an unconscious patient make a faster recovery, Telzey thought. Perhaps Stiltik had the same reflection; she let it go at that. When Telzey made a cautious scan of the area a minute or two later, there was no trace of the giantess in the structure.

Essu appeared in the entrance to the room and wanted to know how much longer it was going to take Sasar to get the human awake and in good enough shape so she could walk. Telzey followed the talk through Couse's mind. Couse was acting as interpreter again. Essu didn't understand the Tanven tongue, nor Sasar that of the Tolants or Elaigar. The physician was alarmed by Essu's indications of impatience, but replied bravely enough. Couse had given him Stiltik's instructions: he was to make sure the patient retained no dangerous injuries before he released her to Essu, and he couldn't be sure of it yet. She appeared to be healing well and rapidly, but her continuing unconsciousness was not a good sign. Essu pronounced a few imprecations in his high sharp voice, resumed his post in the passage.

The signal which caused Essu's shield to relax presently reached it again. Essu wasn't aware of it, but the shield softened in mechanical obedience. This time, it was Telzey's probe which slipped through. She'd reproduced the signal as carefully as she could, but hadn't been too sure it was an exact copy. Evidently she'd come close enough—and now for some quick and nervous work! If Stiltik happened to return before she got organized here, it wasn't likely she could escape discovery.

That part of it then turned out to be easier than she'd expected. Essu's mind already was well organized for her purpose. She flicked through installed telepathic channels to indicated control points. By the time she'd scanned the system, knew she understood it, most of the Tolant's concepts were becoming comprehensible to her. She checked on the immediately important point. What was he to do with her after she came awake and Sasar pronounced her condition to be satisfactory?

Response came promptly. Essu would take her to Stiltik's private lockup, inform Stiltik of the fact, and stay with Telzey until Stiltik wanted her. The lockup was a small sealed circuit section known only to Stiltik and Essu. Stiltik believed the human psi would be an important catch. She didn't want her enemies to hear

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about it until she'd finished squeezing the truth from the Alatta, and had searched through Telzey's mind for information she could turn to political advantage. It appeared Stiltik was engaged in a power struggle with Boragost, the other High Commander in the Elaigar circuit.

Essu's shield hardened again until it appeared solidly locked, though a really close investigation would have revealed that contact remained now between his mind and Telzey's. Telzey didn't want to break that contact unless she had to. The Tolant should turn out to be as useful as she'd thought, and she had to do a good deal of work on him before he'd be ready for use—which made it time to be restored officially to consciousness and health. Once Stiltik was informed the prisoner was safely in the lockup, she should be satisfied to leave it to Essu to see Telzey stayed there.

And that would be essential for a while.

A thought whispered, "I know you're planning to escape from the Elaigar! Would you permit me to accompany you?"

For an instant Telzey froze in shock. That had been a human thought. Otherwise there hadn't been—and still wasn't—the slightest indication of another human being around. She flicked back a question. "Where are you?"

"Not far away. I could be with you in a minute."

Now she'd noticed something. "You're human?" she asked.

"Of course. My name is Thrakell Dees."

"It seems to me," Telzey remarked, "there's something here that could be part of the two Tanven minds I've been in contact with—or perhaps a third Tanven mind. But if you look closely, it's only the impression of a Tanven mind."

Silence for a moment. "A projected form of concealment," Thrakell Dees's thought said then. "One of the means I've developed to stay alive in this cave of devils."

"How do you happen to be in the circuit?"

"I was trapped here over six years ago when the Elaigar suddenly appeared. I've never found a way to get out."

Telzey gave Essu's mind a questioning prod. "You mean you don't know where the exits to Tinokti are?" she asked Thrakell Dees.

"I have an approximate idea of where they should be. However, they're very securely guarded."

Yes, wild humans, Essu was thinking. Quite a number of humans had managed to hide out in the circuit in the early period. Hunting them had been good sport for a while. There were occasional indications that a few still survived, skulking about in unused sections.

"What happened to the other human beings in the circuit?" Telzey asked Thrakell Dees.

"The Elaigar and their serfs killed

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most of them at once. I myself was nearly caught often enough in those days. Only my psi abilities saved me. Later I learned other methods of avoiding the creatures. The circuit is very large, and only a part of it is occupied by them."

"Is anyone left besides you?"

"No, I'm the last. A year ago I encountered another survivor, but he was killed soon afterwards. The Elaigar have brought in captured humans from time to time, but none ever escaped and few lived long. Today I learned from a serf mind that Stiltik had trapped a human psi. I began looking for you, thinking I might be of help. But it seems you have your own plans. I suggest we cooperate. I can be very useful."

"What do you know about my plans?" Telzey asked.

"Nothing directly. Your thoughts were too closely screened. But I've been following the responses you drew from the Tanvens. They indicate you intend to attempt an escape."

"All right," Telzey said. "I will try to escape. If you want to come along, fine. We should be able to help each other. But keep out of the way now, because I'll be busy. The Tolant will be taking me somewhere else soon. Can you follow without letting him see you?"

"I'm rarely seen unless I want to be." His reply seemed to hold a momentary odd note of amusement. "I can follow you easily in the general circuit. I have keys for some sealed areas, too. Not, of course, for all of them."

"We'll be in a sealed area for a while, but we'll come back out," Telzey told him. "Let's not talk any more now. I'm going to wake up."

She dissolved the memory taps in the Tanven minds and that of the old Elaigar, stirred about on the cot, then opened her eyes, looked up into Couse's green face and glanced over at Sasar who had drawn back a trifle when she began to move.

"What's happened?" Telzey asked. She looked at Couse again, blinked. "You're the interpreter . . ."

"Yes, I am," said Couse.

Sasar said in the Tanven tongue, "What is the human saying? Ask her how she feels," the thoughts carrying through the meaningless sound. Essu, hearing the voices, had appeared in the entrance again and was watching the group.

Couse relayed the question, adding that Sasar had been acting as Telzey's physician after she had been injured. Telzey shifted her shoulders, twisted her neck, touched herself cautiously.

"He's a very good physician!" she told Couse. "I'm still aching a little here and there, but that's all."

Couse translated that twice, first for Sasar, and then for Essu, who had some understanding of translingue but not enough to be certain of what Telzey was saying.

"The human aches a little!" Essu repeated. "It's awake and it can

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walk, so it's healthy enough. Tell your healer he's relieved of his responsibility, and be on your way, both of you!"

The Tanvens left quickly and quietly. There was a belt of woven metal fastened around Telzey's waist, with a strap of the same material attached to the belt. The other end of the strap was locked to the wall beyond the cot. Essu unfastened it now and brought Telzey flopping off the cot to the floor with a sudden haul on the strap. A short green rod appeared in Essu's free hand then. He pointed it at Telzey's legs, and she felt two sharp insect stings.

"Get *hup!*" said Essu, practicing his translingue.

She got up. He shoved her hands through loops in the back of the belt, and tightened the loops on her wrists. Then he took the end of the strap and left the room with the prisoner in tow. The Tanvens had turned right along the passage. Essu turned left. A closed door blocked the end, and as they approached it, he took something from his pocket, touched the device to the doorlock. The door swung open. They went through into an extension of the passage, and the door swung shut on its lock behind them.

There was a sudden heavy stirring in Telzey's mind . . . Elaigar thoughts. The old male was coming alert. She realized suddenly he could hear them. This seemed to be his area—and Essu was unaware it had an occupant. There was a heavily curtained doorspace in the wall just ahead—

As they came up to it, the curtains were swept aside and a huge Sattaram loomed above them. She felt Essu's shock of alarm. Then the Elaigar's hand flicked out with the same startling speed Stiltik had shown. Telzey was struck across the side of the head, went stumbling back against the wall. With her hands fastened behind her, she couldn't get her balance back quickly enough and sat down.

It hadn't been too hard a blow—from the giant's point of view no more than a peevish cuff. But he wasn't finished. He'd whipped a heavy knife from his belt, and was looking down at her. A human! He'd had no sport for too long a time. His lip curled, drawing up from big yellowed teeth.

Telzey felt dismay rather than fright. Fast-moving they were—but this Elaigar's mind was open to her and he wasn't aware of the fact. She could slash psi-death into it through the sloppily held screens before the knife touched her skin.

But that could cost her too much—Essu, for one thing. He knew she was a psi, and if a Sattaram died in the act of attacking her, he wasn't likely to consider it a coincidence. He'd try to get the information to Stiltik at once. She was beginning to develop some degree of control over Essu but was unsure of its effect on the unfamiliar Tolant mind. In any case, she couldn't control him enough at pres-

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ent to override any sudden strong motivation. She might have to kill him in the same manner.

It was Essu who saved matters then.

He'd hung on to the end of the strap when Telzey fell, but he stood as far from her and the Elaigar as he possibly could, arm stretched out, eyes averted from both, as if detaching himself completely from this unpleasant situation. When he spoke in the Elaigar language, he appeared to be addressing the wall before him.

"Glorious One—is it your intention to deprive *Stiltik* of prey?"

Slow surge of alarm in the old Sattaram. Stiltik? The hate-filled eyes grew vague. He swung his ponderous head toward the Tolant, stared a long moment, then turned and lumbered back through the doorspace. The curtains swung shut behind him.

Essu was beside Telzey, jerking her up to her feet.

"Come! Come!" he hissed in translingue.

They hurried quietly on along the passage.

VI

Essu, though a bold being, had been shaken by the encounter, and it continued to preoccupy him. As a rule, the green uniform of Stiltik's servants was safeguard enough against mistreatment by other Elaigar even when they weren't aware that he was her valued assistant. But when age came on them, they grew morose and became more savage and unpredictable than ever. The great knife might have turned swiftly on him after it finished Telzey; and to use one of the weapons on his belt then would have been almost as dangerous for Essu as not using them. Self-defense was no excuse for killing or injuring one of the masters.

Much greater, however, had been his fear of facing Stiltik after letting her prisoner get killed. He blamed Telzey for putting him in such a terrible predicament, and was simmering with vengeful notions. But he didn't let that distract him from choosing the rest of their route with great care.

Telzey, aware of Essu's angry spite, was too busy to give it much consideration. Being involved in Stiltik's business, the Tolant knew a great deal more about the circuit and what went on in it than the Tanvens; she was getting additional information now. The four Alattas involved in bringing her into the circuit had been operating here as Otessans—Tscharen and the woman Kolki Ming in Stiltik's command, the other two in Boragost's. Tscharen was permanently stationed in the circuit; the others were frequently given outside assignments. Stiltik had been watching Tscharen for some time; her spy system indicated he was occasionally engaged in off-duty activities in unused sealed areas, and she had her scientists set up traps. His secret meeting with the other three and the human they'd brought into the cir-

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cuit with them was observed on a scanner. Knowing now that she dealt with Alatta infiltrators, Stiltik sprang her traps. But so far only Tscharen and the human had been caught. The others had withdrawn into sealed sections, and a search force of Elaigar and Tolants sent to dig them out had run into difficulties and returned empty-handed.

This obviously was a vast portal system which might almost rival the Luerral in its ramifications. Essu had seen a good deal of it on Stiltik's business, but by no means every part; and he was no more aware of exits to the planet or able to consider the possibility of making use of them than the Tanvens. How the Elaigar could have taken over such a complex, and killed off the humans living there, without creating a stir on Tinokti, was something else he didn't know. The answer might be found in the material Telzey's memory tap had drawn from the old Elaigar, but she couldn't spare time to start sorting through that at present.

None of the sections along their route seemed to be in use by the Elaigar. It was like moving about parts of a deserted city through which a marauding army had swept, stripping all removable equipment from some points while others remained overlooked. Where maintenance machinery still functioned completely, it often appeared that the former occupants might have left only the day before.

But all was silent; all was psi-blocked. Even where daylight or starshine filled empty courtyards or flowering gardens, impenetrable energy screens lay between them and the unaware world outside.

The arrangements of Stiltik's lockup were much like those in the series of sections through which Tscharen had taken Telzey. It lay well within a sealed area, and its connecting portals showed no betraying gleam, remained barely visible for the moment it took Essu and Telzey to pass them. The Tolant shoved her eventually into a small room, slammed and locked the door. She stayed with him mentally as he went off down a passage to report by communicator to Stiltik, who might be on the far side of Tinokti now.

He returned presently. The Elaigar commander had indicated it still could be several hours before she sent for them. When he opened the door, the prisoner was leaning against the wall. Essu went over to the single large cot the room contained, sat down on it, and fixed his round white eyes on the human.

Telzey looked at him. Torture and killing were the high points of Essu's existence. She didn't particularly blame him. Tolants regarded warfare as the natural way of life, and when a group found itself temporarily out of neighbors, it relieved the monotony by internal blood feuds. Under such conditions, the exercise of cruelty was the antidote to fear, became a practical virtue. Elai-

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gar service had done nothing to diminish the tendency in Essu.

If he hadn't been required to take on responsibility for the human captive, he would have been assisting Stiltik now in her interrogation of Tscharen. That pleasure was denied him. The human, in addition, very nearly had placed him in the position of becoming a candidate for Stiltik's lingering attentions himself. Clearly, she owed him something! He couldn't do much to her, but Stiltik wouldn't begrudge him some minor amusements to help while away the waiting period.

Very deliberately then, Essu brought out the green device with which he'd jabbed Telzey before, and let her look at it.

Telzey sighed. She was now supposed to display fear. Then, after she'd cringed sufficiently at the threat of the prod, the hot stings would begin. If necessary, she could shut out most of the pain and put up with that kind of treatment for quite a while. Essu wouldn't risk carrying it far enough to incapacitate her. But it seemed a good time to find out whether it was still necessary to put up with anything at all from him.

She sent a series of impulses through one of the control centers she'd secured in Essu's mind. Essu carefully turned the green rod down, pointed it at his foot. One of his fingers pressed a button. He jerked his foot aside and uttered a shrill yelp. Then he quietly returned the rod to his pocket.

It was a good indication of solid control. However, she didn't feel quite sure of the Tolant. An unshielded telepathic mind which wasn't resisting might be taken over almost in moments by another psi, particularly if the other psi was of the same species. All required channels were wide open. A nontelepathic mind, even that of another human, could require considerable work. In Essu's mind, nontelepathic and nonhuman, there were many patterns which closely paralleled human ones. Others were quite dissimilar. Stiltik had left a kind of blueprint in there for Telzey to follow, but she didn't know whether she'd interpreted all the details of the blueprint correctly.

She put in some ten minutes of testing before she was certain. Essu performed perfectly. There was no reason to think he wouldn't continue to perform perfectly when he was no longer under direct control.

They left the sealed area together, moved on quickly. Stiltik wasn't likely to come looking for them soon, but as a start, Telzey wanted to put considerable distance between herself and the lockup. Some while later, she was on a narrow gallery overlooking a huge hall, watching Essu cross the hall almost two hundred yards below. He knew where he could pick up a set of circuit maps without drawing attention to himself, was on his way to get them. Dependable maps of the portal system

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was one of the things she was going to need. She'd kept one of Essu's weapons, a small gun which didn't demand too much experience with guns to be used effectively at close range. She also was keeping his key pack, except for the keys he needed for his present mission.

She followed him mentally. Essu knew what he was doing and it wouldn't occur to him to wonder why he was doing it. He'd simply serve her with mechanical loyalty, incapable of acting in any other way. As he reached the portal toward which he'd been headed and passed through it, his thought patterns vanished. But here, within the psi blocks enclosing the great hall and part of the structure behind Telzey, something else remained. The vague impression of a Tolant mentality.

So that veteran wild human Thrakell Dees had managed to follow them, as he'd said he would, and was now trying to remain unobtrusive! Telzey considered. Shortly after the encounter with the old Elaigar, she'd become aware of Thrakell's light, stealthy probe at her screens. She'd jabbed back irritatedly with psi and drawn a startled reaction. After that, Thrakell refrained from manifesting himself. She hadn't been sure until now that he was around.

He might, she thought, turn out to be more of a problem than a help. In any case, they'd have to have a definite understanding if they were to work together to reach a portal exit. He'd soon realize that Essu had left the area. Telzey decided to wait and see what he would do.

She settled herself on the gallery floor behind the balustrade, from where she could keep watch on the portal where Essu presently would reappear, and began bringing up information she'd tapped from the old Elaigar's mind and hadn't filtered through her awareness yet. She could spend some time on that now. Part of her attention remained on Thrakell's dimly shifting Tolant cover impressions.

The hodgepodge of information started to acquire some order as she let herself become conscious of it. The Elaigar's name was Korm. He had been Suan Uwin once, a High Commander, who had fallen into disgrace . . .

She made some unexpected discoveries next.

They seemed a stranger variation of the human race than she'd thought, these Elaigar! Their individual life span was short—perhaps too short to have let them develop the intricate skills of civilization if they'd wanted to. As they considered it, however, mental and physical toil were equally unworthy of an Elaigar. They prided themselves on being the masters of those who'd acquired advanced civilized skills and were putting that knowledge now to Elaigar use.

She couldn't make out clearly what Korm's measurement of time came to in Federation units, but by normal human standards, he wasn't

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more than middle-aged, if that. As an Elaigar, he was very old. That limitation was a race secret, kept concealed from serfs. Essu and the Tanvens assumed Sattarams and Otessans were two distinct Elaigar strains. But one was simply the mature adult, the other the juvenile form, which apparently made a rather abrupt transition presently to adulthood.

The Alattas? A debased subrace. It had lost the ability to develop into Sattarams, and it worked like serfs because it had no serfs. Beyond that, the Alattas were enemies who might threaten the entire Elaigar campaign in the human Federation—

Telzey broke off her review of Korm's muddled angry mind content.

Had there been some change in those fake Tolant impressions put out by Thrakell Dees? . . . Yes, there had! She came fully alert.

"Thrakell?"

No response. The impressions shifted slowly.

"You might as well start talking," she told him. "I know you're there!"

After a moment, his reply came sulkily. "You weren't very friendly a while ago!"

He didn't seem far away. Telzey glanced along the gallery, then over at the door through which she'd come out on it. Behind the door, a passage ran parallel to the gallery. Thrakell Dees probably was there.

She said, "I didn't think it was friendly of you either to try to get to my mind when you thought I might be too busy to notice! If we're going to work together, there can't be any more tricks like that."

A lengthy pause. The screening alien patterns blurred, reformed, blurred again.

"Where did you send the Tolant?" Thrakell Dees asked suddenly.

"He's getting something for me."

"What kind of thing?"

This time it was Telzey who didn't reply. Stalling, she thought. Her skin began to prickle. What was he up to?

She glanced uneasily up and down the gallery. He wasn't there. But—

Her breath caught softly.

It was as if she'd blinked away a blur on her vision.

She took Essu's gun from her jacket pocket, turned, pointed the gun toward the gallery wall on her right.

And there Thrakell Dees, moving very quietly toward her, barely twenty feet away, came to an abrupt halt, eyes widening in consternation.

"Yes, I see you now!" Telzey said between her teeth, cheeks hot with anger. "I know that not-there trick! And it won't work on me when I suspect it's being used."

Thrakell moistened his lips. He was a bony man of less than average height, who might be forty years of age. He wore shirt and trousers of mottled brown shades, a round white belt encircling his waist in two tight loops. He had small intent blue eyes, set deep under thick brows, and a

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high bulging forehead. His long hair was pulled sharply to the back of his head and tied there. A ragged beard framed the lower face.

"No need to point the gun at me," he said. He smiled, showing bad teeth. "I'm afraid I was trying to impress you with my abilities. I admit it was a thoughtless thing to do."

Telzey didn't lower the gun. She felt quite certain there'd been nothing thoughtless about that stealthy approach. He'd had a purpose; and whatever it had been, it wasn't simply to impress her with his abilities.

"Thrakell," she said, "just keep your hands in sight and sit down over there by the balustrade. You can help me watch the hall while I watch you. There're some things I want you to tell me about—but better not do anything at all to make me nervous before Essu gets back!"

He shrugged and complied. When he was settled on the floor to Telzey's satisfaction, she laid the gun down before her. Thrakell might be useful, but he was going to take watching, at least until she knew more about him.

He seemed anxious to make amends, answering her questions promptly and refraining from asking questions himself after she'd told him once there was no time for that now.

The picture she got of the Elaigar circuit was rather startling. What the Service was confronted with on Tinokti was a huge and virtually invisible fortress. The circuit had no official existence; there never had been a record of it in Tongi Phon files. Its individual sections were scattered about the planet, most of them buried among thousands of sections of other circuits, outwardly indistinguishable from them. If a section did happen to be identified and its force screens were overpowered, which could be no simple matter in populated areas, it would be cut automatically out of the circuit from a central control section, leaving searchers no farther than before. The control section itself lay deep underground. They'd have to start digging up Tinokti to locate it.

Then there was a device called the Vingarran, connected with the control section. Telzey had found impressions of it in the material drawn from Korm's mind. Korm knew how the Vingarran was used and hadn't been interested in knowing more. Thrakell couldn't add much. It was a development of alien technology, constructed by the Elaigar's serf scientists. It was like a superportal with a minimum range which made it unusable within the limited extent of a planet. Its original purpose might have been to provide interplanetary transportation. The Elaigar used it to connect the Tinokti circuit with spaceships at the fringes of the system. They came and went customarily by that method, though there were a number of portal exits to the planetary surface. They were in no way trapped here by the Service's investment of Tinokti.

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"How could a circuit like that get set up in the first place?" Telzey asked.

Thrakell bared his teeth in an unpleasant grimace.

"Phons of the Institute planned it and had it done. Who else could have arranged it secretly?"

"Why did they do it?"

He shrugged. "It was their private kingdom. Whoever was brought into it, as I was one day, became their slave. Escape was impossible. Our Phon lords were responsible to no one and did as they pleased—until the Elaigar came. Then they were no more than their slaves and died with them."

Telzey reflected. "You've been able to tap Elaigar minds without getting caught at it?" she asked.

"I've done it on occasion," Thrakell said, "but I haven't tried it for some time. I made a nearly disastrous slip with a relatively inexperienced Otessan, and decided to discontinue the practice. An Elaigar mind is always dangerous—the creatures are suspicious of one another and alert for attempted probes and controls. Instead I maintain an information network of unshielded serfs. I can pick up almost anything I want to know from one or the other of them, without running risks." He added, "Of course, old Korm can be probed rather safely, as I imagine you discovered."

"Yes, I did," Telzey said. "Then you've never tried to control one of them?"

Thrakell looked startled. "That would be most inadvisable!"

It might be. Telzey said, "By our standards, Korm isn't really old, is he?"

"Not at all!" Thrakell Dees seemed amused. "Twenty-four Federation years, at most."

"They don't live any longer than *that?*" Telzey said.

"Few live even that long! One recurring satisfaction I've had here is to watch my enemies go lumbering down to death, one after the other, these past six years. Stiltik, at seventeen, is in her prime. Boragost, now twenty, is past his. And Korm exists only as an object lesson."

Telzey had seen that part vividly in Korm's jumbled recalls. Sattarams, male or female, weren't expected to outlive their vigor. When they began to weaken noticeably, they challenged younger and stronger Sattarams and died fighting. Those who appeared hesitant about it were taken to see Korm. He'd held back too long on issuing his final challenge, and had been shut away, left to deteriorate, his condition a warning to others who risked falling into the same error.

She learned that the Elaigar changed from the Otessan form to the adult one in their fourteenth year. That sudden drastic metamorphosis was also a racial secret. Otessans approaching the point left the circuit; those who returned as Sattarams weren't recognized by the serfs.

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Thrakell could add nothing to the information about the Alattas Telzey already had gathered. He knew Alatta spies had been captured in the circuit before this; they'd died by torture or in ritual combat with Sattaram leaders. There was a deadly enmity between the two obviously related strains.

On the subject of the location of the Elaigar home territories, he could offer only that they must be several months' travel from the Hub clusters. And Korm evidently knew no more. Space navigation was serf work, its details below an Elaigar's notice.

"Have they caught the three Alattas who got away from Stiltik yet?" Telzey asked.

There Thrakell was informed. He'd been listening around among his mental contacts before following Telzey to the hospital area. The three still had been at large at that time, and there seemed to be no immediate prospect of catching up with them. They'd proved to be expert portal technicians who'd sealed off sizable circuit areas by distorting portal patterns and substituting their own. Stiltik's portal specialists hadn't been able to handle the problem. The armed party sent after the three was equipped with copies of a key pack taken from Tscharen but had no better luck. The matter wasn't being discussed, and Thrakell Dees suspected not all of the hunters had returned.

"Stiltik would very much like to be able to announce that she's rounded up the infiltrators," he said. "It would add to her prestige which is high at present."

"Apparently Stiltik and Boragost—the Suan Uwin—don't get along very well?" Telzey said.

He laughed. "One of them will kill the other! Stiltik doesn't intend to wait much longer to become senior Suan Uwin, and she's generally rated now as the deadliest fighter in the circuit. The Elaigar make few of our nice distinctions between the sexes."

Boragost's qualities as a leader, it appeared, were in question. Stiltik had been pushing for a unified drive to clear the Alattas out of the Federation. She'd gained a large following. Boragost blocked the move, on the grounds that a major operation of the kind couldn't be carried out without alerting the Federation's humans to the presence of aliens. And now Boragost had committed a blunder which might have accomplished just that. "You know what dagens are?" Thrakell asked.

"Yes. The mind hounds. I saw Stiltik's when they caught me."

He shifted uncomfortably. "Horrible creatures! Fortunately, there're only three in the circuit at present because few Elaigar are capable of controlling them. A short while ago, Boragost fumbled a dagen kill outside the circuit."

Telzey nodded. "Four Phons in the Institute. That wasn't planned then?"

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"Far from it! Only one of the Phons was to die, and that neither in the Institute nor in the presence of witnesses. But Boragost failed to verify the victim's exact whereabouts at the moment he released the mind hound, and the mind hound, of course, went where the Phon was. When it found him among others, it killed them, too. Stiltik's followers claim that was what brought the Psychology Service to Tinokti."

"It was," Telzey said. "How will they settle it?"

"Almost certainly through Stiltik's challenge to Boragost. The other high-ranking Sattarams in the Hub have been coming in with their staffs through the Vingarran Gate throughout the week. They'll decide whether Boragost's conduct under their codes entitles Stiltik to challenge. If it does, he must accept. If it doesn't, she'll be deprived of rank and returned to their home territories. The codes these creatures bind themselves by are iron rules. It's the only way they have to avoid major butcheries among the factions."

Telzey was silent a moment, blinking reflectively at him.

"Thrakell," she said, "when we met, you told me you were the last human left alive in the circuit."

His eyes went wary. "That's right."

"There's been someone besides us with a human mind in this section for some little while now," Telzey told him. "The name is Neto. Neto Nayne-Mel."

VII

Thrakell Dees said quickly, "Have nothing to do with that creature! She's dangerously unbalanced! I didn't tell you about her because I was afraid you might think of letting her join us."

"I am letting her join us." Telzey said.

Thrakell shook his head violently. "I advise you strongly against it! Neto Nayne-Mel is unpredictable. I know that she's ambushed and killed two Elaigar. She could endanger us all with her hatreds!"

Telzey said, "I understand she was a servant of the Elaigar in the circuit for a couple of years before she managed to get away from them. I suppose that might leave someone a little unbalanced. She's got something for me. I told her to bring it here to the gallery."

Thrakell grimaced nervously. "Neto's threatened to shoot me if she finds me within two hundred yards of her!"

"Well, Thrakell," Telzey said, "she may have caught you trying to sneak up on her, like I did. But that won't count now. We're going to need one another's help to get out. Neto understands that."

Thrakell argued no further. He still looked quite upset, due in part perhaps to the fact that there'd been a mental exchange between Neto and Telzey of which he'd remained unaware.

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A human being who was to stay alive and at large for any length of time in the Elaigar circuit would need either an unreasonable amount of luck or rather special qualities. Thrakell, along with the ability to project a negation of his physical presence, had mental camouflage, and xernotelepathy which enabled him to draw information from unsuspecting alien mentalities around him.

Neto was otherwise equipped. Her mind didn't shield itself, but its patterns could be perceived only by a degree of psi sensitivity which Thrakell Dees lacked, and the Elaigar evidently also lacked. She'd devised a form of physical concealment almost as effective as Thrakell's. Her other resources were quick physical reactions and a natural accuracy with a gun which she'd discovered after escaping from her masters. She'd killed four Elaigar since then, not two. Her experiences had, in fact, left her somewhat unbalanced, but not in a way Telzey felt at all concerned about.

A few minutes later, Neto stepped out suddenly on the gallery a hundred feet away and started toward them. The figure they saw was that of a Fossily mechanic, one of the serf people in the circuit—a body of slim human type enclosed by a fitted yellow coverall which left only the face exposed. The face was a mask of vivid black and yellow lines. Neto was almost within speaking distance before the human features concealed by the Fossily face pattern began to be discernible.

That was the disguise Neto had adopted for herself. Fossily mechanics, with their tool kits hung knapsackwise behind their shoulders, were employed almost everywhere in the circuit and drew no attention in chance encounters. Moreover, they had a species odor profoundly offensive to Elaigar nostrils. Their coverall suits were chemically impregnated to hide it; and the resulting sour but tolerable smell also covered the human scent. A second yellow tool bag swung by its straps from Neto's gloved left hand. In it was a Fossily suit for Telzey, and black and yellow face paint.

Essu returned not long afterwards. Telzey touched his mind as he appeared in the portal down in the great hall, and knew he'd carried out his assignment. A pack of circuit diagram maps was concealed under his uniform jacket. He hadn't let himself be seen.

He joined them on the gallery, blandly accepting the presence of two wild humans and the fact that Telzey and Neto were disguised as Fossily mechanics. Telzey looked at Thrakell Dees.

Thrakell could be a valuable confederate. Could be. She wasn't sure what else he might be. Neto suspected he was a murderer, that he'd done away with other circuit survivors. There was no proof of it, but Telzey hadn't taken her attention off

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him since she'd caught him stalking her in his uncanny manner on the gallery, and there'd been an occasional shimmer of human thought through the cover pattern, which he'd changed meanwhile to that of a Fossily mechanic. She'd made out nothing clearly, but what she seemed to sense at those moments hadn't reduced her uneasiness about Thrakell.

"Thrakell," she said, "before we get down to business, I'm giving you a choice."

He frowned. "A choice?"

"Yes. What I'd like you to do is to give up that Fossily cover and open your screens for a minute, so I can see what you're thinking. That would be simplest."

Thrakell shook his head. "I don't understand."

Neto chuckled softly.

"Oh, you understand," Telzey said. "You wanted to come along when I try to get out of the circuit, so you are coming along. But we didn't get off to a good start, and I don't feel I can take you on trust now. You could prove I can by letting me look at your mind. Just the surface stuff—I want to know what made you decide to contact me, that's all."

Thrakell's small eyes glittered with angry apprehension. But his voice was even. "What if I refuse?"

"Then Essu will take your weapons and circuit key pack."

Thrakell looked shocked. "That's completely unfair! If we became separated, I'd be confined to whatever section I happened to be in. I'd be helpless!"

"Well, that will make you see to it we *don't* get separated," Telzey said. "I don't think we should now. Which will it be?"

Thrakell jerked his head sullenly at Neto. "What about her?"

"She's sure of me," Neto told him. "Quite, quite sure! She's already been all through my mind, that's why!" She laughed.

Essu, round white eyes fixed on Thrakell, reached for a gun on his belt, and Thrakell said hastily, "Let the Tolant have the articles then! I rarely use a weapon, in any case. I detest violence."

Essu began going over him with his search devices. Telzey and Neto looked on.

Telzey could, in fact, be very sure of Neto. Neto had known no hope of escape from the circuit. She'd lived by careful planning and constant alertness for the past two years, a vengeful, desperate ghost slipping about the fringe areas which would open to the portal keys she'd obtained, as wary of the few wild humans who'd still been around at first as of the Elaigar and their alien servants. There were periods when she no longer believed there was a world outside the circuit and seemed unable to remember what she had done before she met the Elaigar. At other times, she was aware of what was happening to her and knew there could be only one end to that.

Then, once more trailing the mur-

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derer who could slip up on you invisibly if you weren't careful, trying to determine what sort of mischief he was involved in, she'd touched a new mind.

In moments, Neto knew something like adoration. She'd found a protector, and gave herself over willingly and completely. Let this other one decide what should happen now, let her take control, as she began doing at once.

Neto's stresses dissolved in blind trust. Telzey saw to it that they did.

"Two problems," Telzey remarked presently. "The diagrams don't show exits to Tinokti, and they seem to add up to an incomplete map anyway. Then the keys we have between us apparently won't let us into more than about a fourth of the areas that look worth checking out. We could be one portal step away from an exit, know it's there, and still not be able to reach it."

Thrakell said sourly, "I see no way to remedy that! Many sections have a specialized or secret use, and only certain Elaigar leaders have access to them. That might well be the case with sections containing planetary exits. Then there's the fact that the Alatta intruders have altered the portal patterns of large complexes. I'm beginning to suspect you'll find yourself no more able to leave the circuit than we've been!" He glanced briefly over at Neto.

"Well," Telzey said, "let's try to get the second problem worked out first. Essu knows where he can get pretty complete sets of portal packs. But he will need help."

"What place is that?" asked Thrakell suspiciously. "As far as I know, only the Suan Uwin possess omnipacks."

"That's what Essu thinks. These are in a safe in one of Stiltik's offices. He can open the safe."

Thrakell shook his head.

"Impossible! Suicidal! The headquarters of the Suan Uwin are closely guarded against moves by political enemies. Even if we could get into Stiltik's compound, we'd never get out again alive!"

Neto said boredly to Telzey, "Why don't you lock this thing up somewhere? We can pick him up afterwards, if you feel like taking him along."

That ended Thrakell's protests. It wasn't, in fact, an impossible undertaking. Stiltik used Essu regularly to carry out special assignments which she preferred not to entrust even to close followers. There was a portal, unmarked and unguarded, to which only she and the Tolant had a key. If they were careful, they could get into the headquarters compound.

They did presently. They were then in a small room behind a locked door. To that door again only Stiltik and Essu had keys. Unless Stiltik happened to come in while they were there, they should be safe from detection.

Telzey scanned, while her com-

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panions remained behind cover. It took time because she went about it very carefully, touching minds here and there with gossamer lightness. Details gradually developed. At last she thought she'd gathered a sufficiently complete picture.

Elaigar minds were about—some two dozen. There was no trace of Stiltik. The Suan Uwin appeared to be in an interrogation complex with the captured Alatta; and that understandably was a psi-blocked unit. There were Tolant minds and two unfamiliar alien mind types here. The serfs didn't count, and the only Elaigar in the central offices were two bored Otessan females, keeping an eye on the working staff. They might notice Essu going into Stiltik's offices presently, but there was nothing unusual about that. They weren't likely to be aware he was supposed to be somewhere else.

Another of the minds around might count for a great deal. It was that of Stiltik's dagen.

In her first encounter with one of those beasts, Telzey had felt and been nearly helpless. She was grate-

in times to come

Next month's issue carries a cover by a too-long missing artist—Jack Schoenherr is back. Matter of fact, he's just back from shooting various forms of wildlife native to the foothills of the Himalaya Mountains in Iran—shooting with a long-lens camera, that is. Jack hasn't been around much so far as we were concerned, because he was around all over—like Thule on an Air Force assignment, and assorted interesting other places, and doing books.

But he's back for a while, at least.

The story is by F. Paul Wilson, titled "Wheels Within Wheels," and concerns an inconspicuous dictator of a planet—which seems a sort of contradiction in terms. But he was a sort of unusual dictator—he wasn't smart, strong, wily, unusually wise, attractive, had no charisma—yet both the natives of the planet and the human colonists did what he said. Because he was, in his own way, quite talented. And a mean, petty—but very deadly!—little tyrant.

Also in that issue will be "Strong Poison," a fact article by Dr. Carl A. Larson, of the University of Lund, Sweden, discussing the problems interstellar colonists are apt to encounter in intruding in alien ecologies. When you consider the toxic effects plant pollens can cause human beings here on Earth, where we evolved right with the local life forms, the problems of intrusion into a really alien ecology begins to look a bit unpleasant! ■ *THE EDITOR.*

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ful now for the work she'd put in meanwhile adding to her psi equipment. Her screens hid her from the dagen, and she was able to reach through them toward its mind with delicate sensing probes.

She did. There was no reaction. Cautiously, she began to trace out what she could discern.

The creature was in an enclosure without physical exits. It needed none, of course. On Stiltik's order, it could flick itself into the enclosure and out again.

It could do very little that wasn't done on Stiltik's mental orders. Stiltik had clamped heavy and rigid controls on her monster. A human mind placed under similar controls would have been effectively paralyzed. The dagen's rugged psyche was in no sense paralyzed. It simply was unable to act except as its handler permitted it to act.

It wasn't very intelligent, but it knew who kept it chained.

Telzey studied the controls until she was satisfied she understood them. Then she told Essu to go after the omnipacks in Stiltik's office. She accompanied him mentally, alert for developing problems. Essu encountered none and was back with the packs five minutes later. He'd been seen but disregarded. Nothing seemed to have changed in the headquarters compound.

They left by the secret portal, and Essu handed Telzey its key. She said to the others, "Wait for me here! When I come out, we'll go back along the route we came—and for the first few sections we'll be running."

Thrakell Dees whispered agitatedly, "What are—"

She stepped through the portal into the room. Her mind returned gently to the dagen mind. The beast seemed half asleep now.

Psi sheared abruptly through Stiltik's control patterns. As abruptly, the dagen came awake. Telzey slipped out through the portal.

"Now *run!*"

Essu's haul of portal key packs had been eminently satisfactory. One of them had been taken from Tscharen after his capture. Essu interlocked it with an omnipack, gave the combination to Telzey. She slipped it into a pocket of the Fossily suit. It was small, weighed half as much as Essu's gun which was in another pocket of the suit. But it would open most of the significant sections of the circuit to her. Essu assembled a duplicate for himself with a copy of Tscharen's pack, clamped the other keys together at random, and pocketed both sets. Thrakell Dees looked bitter, but said nothing. The arrangement was that he would stay close enough to Essu to pass through any portal they came to with the Tolant. Neto would stay close to Telzey.

"And now?" Thrakell asked.

"Now we'll pick a route to the hospital area where the Tanvens put me back in shape," Telzey said. "We still want a guide."

To be concluded

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letter from an unknown genius

There can be situations
in which a genius might definitely prefer
that his work of genius
not be associated with him.
It would be a lot safer that way . . .

COLIN KAPP

ILLUSTRATED BY MICHAEL GILBERT

Dancing on a sea of silvery wavelets, the small boat came: under the radar towers, past the brief defenses—the clamor of its tiny engine sounding loud across the bay. The men behind the guns spared it not a second glance. It was an ordinary scene—the priest returning from the blessing of the fishing fleet and the casting of bread upon the waters. This was part of the pattern by which the village lived, a way of life almost unchanged as far as the yellowed records could remember.

Only a shrewd eye, and one equipped with good binoculars and a good memory, would have noticed that this day was different. The boat returning from its mission carried one more occupant than it had taken. Around the shadow of the headland the nuclear submarine, its assignment completed, had already slipped silently across the shelf, making for deep water.

The monastery of San Cherno was old. Its walls, built continuously up from the bedrock of the cliffs, in places dipped almost to the water. Here, past the sad harbor, the great, gray steps of the ecclesiastic landing stage showed for just how many centuries the church of San Cherno had comforted and been concerned with those who fought their living from the sea.

But it was not only the years which had left their mark on the gray and dedicated walls. Scars of the ravages of cannon shell and rocket remained an ineradicable reminder of the impact of the century into which they had survived. As though acknowledging its grudged awareness of the times, the chapel wore a copper crown whose newly acquired patina had not yet learned to live in harmony with the dull stone walls.

The boat pulled in at the landing stage at the foot of the monastery steps. A priest and one other disembarked before the novices turned the craft away to place it at anchorage safe against the tides. The priest permitted the cowl of his cloak to fall back to his shoulders, revealing his curiously sharp, ascetic face and

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the whitened wisps of a tonsured head—a vision of piety who might, unchanged, have occupied the self-same role at any time in the monastery's history. His companion maintained the garb intact, concealing beneath it the casual clothes of one more than usually aware of the progress of the Atomic Age. Not

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until they had ascended the steps and entered the great, shaded halls of San Cherno did the visitor disrobe.

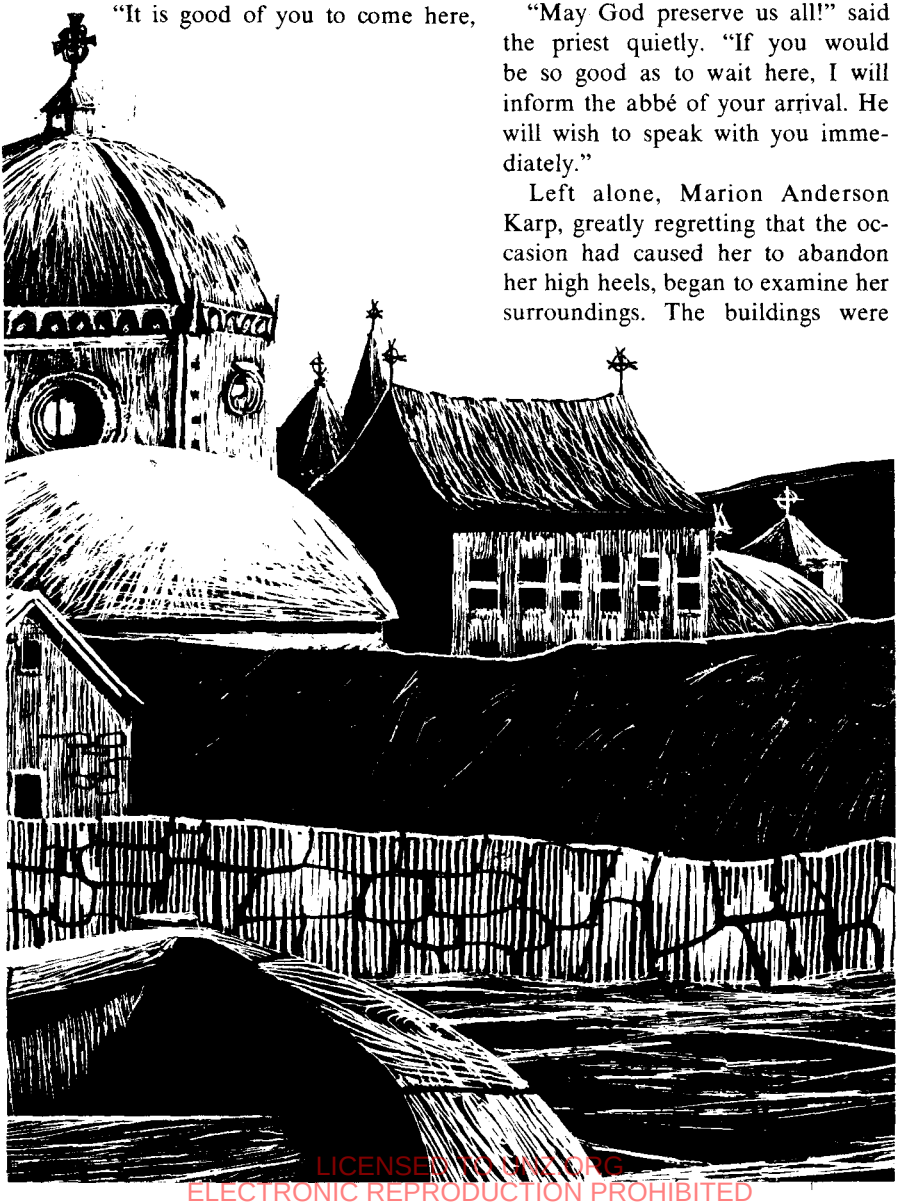
The priest took the cloak from her with an air of deference.

"It is good of you to come here, Madam Karp—especially on so dangerous a journey."

"If the news that has reached us is true, the dangers involved in my coming are nothing compared to the dangers had I not come."

"May God preserve us all!" said the priest quietly. "If you would be so good as to wait here, I will inform the abbé of your arrival. He will wish to speak with you immediately."

Left alone, Marion Anderson Karp, greatly regretting that the occasion had caused her to abandon her high heels, began to examine her surroundings. The buildings were



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classic examples of their age, and the housekeeping was loving and meticulous. But time and war had caused many faults in the fabric, and the process of reconstruction, due to the unlifting poverty of the area, was a labor to be measured in lifetimes rather than years.

She approached the great portal, looking out appreciatively at the incredibly bright sunshine which flooded the headland and the bay, but careful to keep her own self concealed in the shadows against any casual eye. The number of lives set at risk by her presence in San Cherno warned her to great caution, and the nuclear submarine which had delivered her to these shores showed the involvement of governments and the shadowy hand which gripped the world with cold pincers of fear.

The sound of footsteps returning across the flagged halls made her turn. It was the priest, his face nearly impassive yet made rich with the deep, searching eyes and the resolute quietude which was so characteristic of the Order in Residence at San Cherno.

"The abbé awaits you in the library, Madam Karp. If you please, I will show you the way. And may I add this is an historic occasion. Never before in the four hundred and fifty years of San Cherno's existence, has a woman been permitted to enter these walls. Unfortunately it is also an event which must be forever left unrecorded."

"Madam Karp, this is indeed a pleasure!" The abbé extended his hand towards her. Momentarily she hesitated, overwhelmed by the size and richness of the huge, dim library in which the abbé sat. "Forgive me for not rising," he continued, "but it is many years since these legs last served me."

She broke her reverie and went to him quickly. "I wasn't aware of your infirmity, Abbé Mesnil—only of your courage." She shook his hand gravely. "It is I who should apologize."

"Nonsense, Madam . . . my child!" His face was overcome by a kind of wonder. "Please stand more fully in the light, for I think I have been misled. Seroia told me he was sending someone brilliant, but he forgot to tell me he was sending someone beautiful."

"Not beautiful," said Marion Karp reprovingly. "Truth to tell, I'm uncommonly plain."

"That isn't true, my child, but to find these virtues combined with both a sense of humor and of humility is something that happens but once in a lifetime."

"Abbé Mesnil!" Her voice sharpened. "I've not come all this way just to receive compliments."

"Indeed no! But let me say this: had I known Seroia would send . . . you . . . I would probably not have consented. What will be told in San Cherno today places the hearer at great risk. I could expect that much of a man. I would not knowingly

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have imposed it on a woman."

Marion Karp smiled. "Perhaps my society is less chivalrous in what it expects of a woman. And then again, perhaps not. Think what your society demands of a peasant-wife, and then ask yourself who is the more fortunate."

Abbé Mesnil's face softened. "And wisdom also! You are indeed one of the rarer kind."

A knock at the door heralded the arrival of a novice bearing refreshments on a tray. Marion Karp took the offered sweetmeats and sipped the wine appreciatively, her eyes roving the great bookshelves as if trying to summarize her host by the literary environment in which he lived and of which he seemed almost a part. What she saw impressed her. When the novice had departed she returned to the abbé's side.

"Considering you're so isolated from it, Abbé Mesnil, you're remarkably *au fait* with the latest developments of modern science."

The old man smiled. "Does one need to stand in a puddle in order to study animalcula, or to dwell in a vacuum in order to study the stars?"

She faltered momentarily. "My mistake, Abbé. I come so steeped in scientific method I tend to forget the power of thought. May we now come to the matter which brought me here?"

"Surely, my child! First, I will tell you about a man. Later I shall ask you to meet someone and let him tell his own story. I need scarcely warn you that what you will hear could be the cause of your own death at the hands of our secret police, if they should learn of it. Equally it could cause my death and the death of the one you shall meet. It could even bring about a pogrom which would end this church and this village."

"I understand that."

"I'm sure you do. But remember that whoever speaks to you, or who even knows of your presence here, is guilty of high treason in our modern police state. Nor are we willing traitors to the land of our own flesh. We have invited you here in the name of God and in the cause of the preservation of humankind . . . for the sake of Humanity."

"The greater cause . . ." Marion Karp was watching him closely.

"As you say—the greater cause. Even theologians must sometimes accept a compromise."

"May we now get to the point?" Her voice was edged with a hint of intolerance.

Mesnil looked at her for a long second before replying.

"For nearly four centuries our church mission has maintained the village school in San Cherno. Our basic teachings are reading, writing, figures, and the scriptures. However for students of special ability we extend the curriculum. Some we train for higher things here in the monastery, and some we even send to the seminary in Gozaro. Thus no one in the village, no matter what the cir-

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cumstances of his birth, need lack for education if he can prove his ability to learn. One such exceptional student was Pietr Salmonique."

"Pietr Salmonique?"

"The name is unimportant, since no one now owns it. But the lad was gifted at figures, so much so that Brother Amarillo, who was once a lecturer in mathematics, became his personal tutor. Pietr, whose father was a hedge-cutter, proved to be not only exceptional, but brilliant. He outgrew all that we had to offer, and the seminary would have wasted his talents. Although we are a poor Order, we gave him a grant which enabled him to go to the university at San Paulo."

"That much is history." Marion Anderson Karp was still waiting for the point.

"History with a purpose." Mesnil was unruffled. "I seek first to convince you what class of man Pietr Salmonique was."

"Was?"

"Don't force me to jump ahead of my story. Pietr not only gained his doctorate, but the work he did for his thesis showed him to have one of the most brilliant minds in the country, if not in the world. I have myself no doubt that had he been able to continue his work undisturbed his name would one day have ranked alongside that of Einstein."

"He didn't continue, then?"

"The ways of God are never certain. We cannot be sure. In a totalitarian state the truth is not always what appears at the surface. We know he joined the Government Science Institute to do some research work on fundamental physics. That was the last we ever heard of Pietr Salmonique."

"So?"

"That was nearly two years ago. The silence was not unexpected. Our government is ambitious, and their Security is absolute. They had a big research station on the Mariam desert at a place called Gratz, and we presume it was to there that he went. In any event, Gratz was the center of the blowup in which you are interested. That was three months ago."

"What do you know about the Gratz blowup?"

"Only what I hear, and that is pitifully little. Even today the majority of the population in this country are unaware that the blowup even occurred. But I do not think that your observation satellites could have missed it. Some disaster happened at Gratz . . . something that wasn't a nuclear reaction because there was no radiation and no radioactive fallout. Whatever happened was some kind of particulate reaction the like of which the world has never before known. One white flame reached out from Gratz. . . and thirty thousand square kilometers of sand were burned into a film of glassy slag ten meters thick. The Gratz research station and three small villages disappeared in that instant of time—leaving nothing but a glazed enigma."

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"Your information agrees with our own," said Marion Karp evenly. "The Gratz reaction was of an unknown type. It was a far more fundamental type of particulate reaction than our own relatively crude attempts at nuclear fusion and the like. What confused us was that before your mention of Pietr Salmonique, we were reasonably certain that your Government Science Institute had no brains of a stature sufficient to carry out particulate research of that order. I still think that the resources of your country are insufficient to support research of that magnitude."

"That is substantially true, my child. But now to the reason I agreed to allow you to come here. Four days after the blowup a sick man arrived here at San Cherno asking for sanctuary. He was ill for many weeks with a delirium which seemed to be of the mind rather than the body. But in his sickness he talked much, and, being his comforters, we listened. In a little while I'm going to ask you to talk with him yourself."

"He's still here then?"

"Our Order has gained a new brother—Brother Simon. From whence he comes we know not, but he is undoubtedly the most devout and pious amongst us." Mesnil was smiling slightly, as if to belie his own words. "Since this is a day of exceptions, I am releasing him from his vow of silence in order for you to conduct an interview. Remember, since we know nothing about him, I can vouch for nothing that he says, nor even if he is sane or mad. He bears some resemblance to Pietr Salmonique, except that Pietr had dark hair, whilst Simon's is white. Also Pietr was a young man, whilst Simon seems to have no age at all except that his eyes are old."

Her first impression was that the cell was in complete darkness, and it took many seconds for her eyes to adapt before she could make out details of the interior. The walls were of rough, unfinished stone, massive in the way of all things at San Cherno. A plain wooden bench with two coarse blankets served as bed, chair and table. Two iron pins driven into the wall made a more than adequate wardrobe. Light was admitted from one small grille placed high and recessed deeply into the mammoth blocks of stone. The sole relief in the spartan scheme was a great wooden cross upon the wall, on which a carved near-lifesize figurine of Christ hung in eternal anguish. There was also a bible. And a man.

She stood for many minutes watching the man on his knees, his hands together, head raised, eyes closed yet looking upwards to the frozen crucifixion. If he was aware of her he gave no sign, but continued his prayer with a kind of single-minded desperation; as though the world would cease to turn if he should falter. Then, by dropping his hands before him he signaled that the prayer was done.

"Simon?" Marion Karp found her

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voice oddly at variance with her surroundings.

"They call me the same." The man rose from his knees and turned towards her. His face was white, almost silken, against the backdrop of the hood which he pulled around his head. His eyes were deep pools of something which reflected the agony of the figure on the crucifix. As Mesnil had said, he had no age except that his eyes were old.

"The abbé asked me to listen to your story."

"You?" He was slightly incredulous. "I agreed to speak only once and then only to someone capable of comprehending what I have to say—because there is great danger in such knowledge. Only someone who understands completely what I have to tell could decide between my words and the dreams of a madman. But even a fool could attempt to use my words—and one fool did."

"I can understand."

"I think not . . ."

"You doubt my credentials?"

"You are a woman." Simon left the rest unsaid.

"Then you have never heard of Marion Anderson Karp?"

His expression changed suddenly. "Madam Karp . . . the physicist . . . forgive me! You and Curie . . . I know well of your work on particulate theory, but I had not realized that you could be so young and . . ."

". . . Beautiful?"

"Yes . . . an old crow I could have understood."

"It's axiomatic that old crows must once have been young, and many of them beautiful also. Do you wish me to return in fifteen years?"

"Madam . . . I live up to my name. They call me Simon now—in fact it is mostly Simon the Idiot. You see how aptly the name applies. Nobody but an idiot would treat you like this."

Marion Karp laughed lightly. "I would judge you anything but an idiot."

Simon spread his hands expressively. "It is a pose I must adopt in case the police should come. If I maintain it long enough, I suspect it will even become true. But once I was . . ."

"Pietr Salmonique, the mathematician?"

"You have been primed by the abbé, Madam Karp. Therefore my life is in your hands." He gestured for her to sit on the bench, and sat beside her, looking fixedly at the symbol of the cross whilst he spoke. "When I left the university I secured a position at the Science Institute under Professor Ornado. In fact I carried Professor Ornado. He was a fool. His academic degrees were bought, and his appointment as head of the Institute was political. But he was a dangerous fool. He had a little knowledge, but no idea at all of how much he did not know."

"I have met Ornado at conferences," said Marion Karp. "Your summary agrees with my own."

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"Good!" Simon was warming to his subject. "President Perdo, knowing even less about science than he does about government, thought that his expensive Science Institute should be able to give him an atomic bomb. This was ludicrous, but Ornado, to keep his position and possibly his life, became committed to make an attempt. Fortunately neither the Russians nor the Americans would supply us with the necessary isotopes. The Chinese made sympathetic noises but failed to deliver. Ornado decided to go it alone."

"That should have been fairly harmless."

"It should have been—would have been." Simon never once took his eyes from the hanging Christ. "Ornado flew against the books because he hadn't a ghost of a chance of doing it the orthodox way. He began experimenting with hydrogen fusion, apparently under the impression that he could achieve a thermonuclear reaction by subjecting hydrogen under pressure to high-intensity arcs. By this he could have hoped to do no more than placate President Perdo, and thus prolong his own life. But then the letter arrived."

"What letter?"

"A letter from an unknown genius. No name. No address. Simply a set of equations and the suggestion of a method for producing a particulate reaction more basic than anything known in conventional nuclear physics. It could be the type of reaction by which the stars were first lit."

"Go on," said Marion Anderson Karp.

"The mathematics were horrific. I had to develop special techniques to handle the equations. Even then I was only grasping at the edge of a new unified-field theory which I doubt if the human brain has the capacity to encompass as a whole. Limiting myself to only one minuscule part of the problem, I was able to produce a working hypothesis for this new and vastly simpler kind of particulate reaction. Indeed, it was so simple that even Ornado had the type of facilities to make it work."

"And you gave your hypothesis to Ornado for his bomb?"

Simon spread his hands. "I did so with the greatest reservations. I left him in no doubt of the dangers of proceeding with something so far beyond the limits of known physics. In a conventional nuclear fission or fusion reaction, the physics of the reaction causes its own termination. Neither can become self-sustaining. But I could see no such limitation inherent in this new class of reaction. It could have consumed the world or even the universe."

"Yet Ornado still dared to try it?"

"He had nothing to lose, Madam. He would have been quite as dead at the hands of Perdo's police had he not produced a bomb. He was a very frightened man. But he was cautious. He tried quite honestly to test-fire the device under circumstances which involved the minimum risk to

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human life. Nobody could have predicted the actual consequences."

"What happened then?"

"The test-point was in the desert and only some thirty kilometers from Gratz. Ornado had designed that the first reaction would be a very small one. I was sent to the edge of the desert to an observation post. I think something went wrong with his timing, because I was only meters out of the desert and not yet at the post when the blowup came. It was like a sheet of white flame, not a fireball. A low, spreading mass . . . an unholy tide of white fire that burned the desert sand to slag yet had no heat of its own."

"What makes you say it had no heat?" asked Marion Karp.

"There were monitors in the observation post. I looked at them later. There was no heat recorded, and no radioactivity."

"Then what class of reaction was it?"

"I do not know, Madam. It was beyond anything that I know of in physics. I can only tell you what I saw."

"Was there any evidence that the reaction might have been self-sustaining?"

"I think it tended to. That was why it spread across the desert. I have no idea why it stopped when it did. But the visions of that moment will haunt me always. Madam, when I saw that white tide advancing, I knew I had helped destroy the world."

Marion Karp was silent for several long seconds.

"And you say you received the information for this in a letter? What then would you make of the person who wrote it?"

"As I see it, Madam, the reaction was part of some higher order of physical science. But I fail to see who on earth could possess that type of knowledge, or why they used it to play such a potentially disastrous trick on Ornado."

"Listen to me," said Marion Karp, "because what I'm going to say now is very secret and very important. Ornado was not the only one to have a trick played on him. Britain lost a hundred million pound research establishment following-up some anonymous information on tritium fusion. America laid-waste to a vast tract of land trying to prove a theorem on gravitic radiation which arrived in a shoebox. We don't know what happened in Russia, but from her willingness to co-operate in finding the source of this information, it's a reasonable guess that she paid dearly also. We're also sure that something desperate happened in China."

"All through letters from the same genius, Madam?"

"We think so. Somewhere on earth is someone whose extreme genius has permitted him to make a breakthrough into the next order of physics . . . perhaps a hundred, perhaps five hundred years ahead of our time. We have to find this person,

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Simon. Not only to prevent him from tormenting us with our own greed for power, but to be able to understand how and why such mental breakthroughs are possible. The trouble is, how do you find a genius who has a genius for remaining concealed? If there's anything more you can tell us which might be of help, I charge you to tell me now."

"I'm not sure I want you to know more about these breakthroughs, Madam. I sometimes shudder at the thought of what power your country, or mine, or some other, could acquire if they possessed access to that kind of knowledge."

"Knowledge is a tool," said Marion Karp sharply, "and like any other tool, its employment for good or evil depends on the morality of the user. It's too late to point to a certain level of science and say: 'We will stop there!' That chance was lost with the flesh of the apple in the Garden of Eden."

"The original sin," said Simon, with a wan smile. "But does the creator of this knowledge bear no responsibility for what others create from it? I've been trying to understand the motivation behind the person who wrote the letter. I don't know much about the psychology of genius, except the adage that it's akin to madness. Do you think he is mad, Madam?"

"No. Not many of my colleagues agree with me, but I see him as saner than most. There's been no evidence to suggest he's been doing more than tormenting us by displays of his own superiority. It's our own greed which has caused all the damage. One could well think that he's giving us a moral object lesson."

Despite the sullen heat, Simon shivered, and his hands moved together convulsively.

"Madam, I am only Simon the Idiot. Such speculations I must leave to those who can fairly claim to be able to judge them. For myself, I see the only answer lies in prayer."

"I should like to take you back with me to France or England so that we can learn as much as possible about this new dimension in physics."

Simon swung to face her, his eyes curiously dark and appealing. "Madam, there are times in a man's life when nothing is so important as a solid wall against which he can press his back, and a few cubic meters of eternity before him into which he can stare. Reluctantly I must point out that I am no longer strong enough to inhabit the type of world you have to offer."

"I think you're wrong," said Marion Karp. "But if your mind is set, I should like you to tell me in detail all you remember about the Gratz experiment. In particular, I want as much as you can give me of the original equations."

He stopped, as though her profile in silhouette against the light had drawn him back towards a former world.

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"I can do better than that, Madam. With swift decision he stooped and felt in a recess underneath the bench. His hand emerged clasping some sheets of folded paper.

"I had not meant anyone to have this—ever. Not after Gratz. But I think if I gave it to you, you will know best how to use it wisely."

"What is it?"

"I saved it, Madam, and no one knows I have it. It's the letter from the unknown genius."

She took the letter with a frown and opened it, feeling the texture of the paper and holding it up to the light, then holding it down so that she could see the characters inscribed upon it.

"This is the original?"

"Exactly as it arrived, Madam. I had photocopies made, but the original I kept. Now I give it to you."

"This is important, Simon—because incidental things about the original might give us a clue to the identity of its author. Can you be sure that these haven't been confused with some of your intermediate workings?"

Simon touched the pages lightly. "Those symbols are burned into my memory. Not only what was written, but how they were written. I have thought much about the brain which guided that pen. There is no possible doubt that those are the original."

"Thank you," said Marion Karp. "I'd like to go and study these, and, if possible, speak with you again later."

"If the abbé permits it, Madam, then I am at your service. In the name of God, this person must be found."

As evening approached, a novice had come into her room and lit the oil lamps. The paucity of the illumination irritated her, and the heavy curtaining at the windows seemed to shut out what little air there was, and to increase the heat that drained out of the massive stone of the walls. When her search for a breathable atmosphere caused her to open the curtain and the heavy casement, the light attracted all sort of winged beasties out of the gathering dusk, and their phototropic spirals round the flame brought her to the instant of despair.

Across the tabletop of irregular but lovingly-tended wood, her own notes were now scattered, white and rectangular and covered with symbols heavily indebted to a civilization which had risen and been eclipsed two thousand years before. Now the messages which the pages bore seemed to shriek of a similar temporal disparity with their surroundings. In the uncertain shadows cast by the ancient flame, they, too, were things of another time.

Agonized by the conflict of clashing concepts and unresolvable formulas, she flung herself finally on to the bed, spasmodically retrieving first one note and then another as successive but abortive shafts of inspiration moved her like a vexed-

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child's plaything. The dimness and the heat closed more deeply round her and grew steadily more oppressive and less tolerable. Still the answers would not come. The letter which Simon had given her mocked her with its enigma. It was at once both factual and an impossibility. Something, somewhere was incredibly wrong, but the responsible factor could not be isolated or defined. For the first time since childhood, Marion Karp was beginning to feel afraid.

A knock at the door came as a welcome diversion. The priest who had fetched her in the boat now waited for her in the corridor. His quiet calm and certitude contrasted strongly with her own turmoil. For an instant she felt a twinge of something akin to envy at his ability to master the belligerent war fields of internal conflict. His composure was like a rock, whilst she felt like a reed caught in a capricious wind.

"The abbé presents his compliments, Madam Karp, and would be pleased for you to join him for supper in the library. He has asked Brother Simon also to join him, if you have no objection."

"I've no objection, of course. In any case, I need further words with Simon."

The priest led the way through the long stone corridors. He was barefoot and with tonsured head, and walked with the kind of dignity which elsewhere seemed to have vanished from the world. Almost meekly, she followed, feeling curiously like a child being led by the hand. There was something about this place which questioned her own sense of identity.

In the library the long table had been set with an elegant meal. Abbé Mesnil was already seated at its head; and tall white candles in silver candelabra cast a soft, white illumination so in keeping with the scene that it was impossible to imagine their being supplanted by any harsher form of light. On all sides the reflection from the spines of many thousands of cherished books turned back the precious glow, cradling the space within in a kind of timelessness. A womb lined with books . . .

"Please be seated, my child! You seem a little weary. I hope that our somewhat spartan mode of life has not unduly taxed you."

"Spartan?" She glanced at the rich cloth, the silver, the plate and the rare cut glass, and at the lights which danced back from the old man's eyes.

"Don't judge us by what you see here. This is our day of exceptions. I doubt if this table has felt such weight this century. It is our way of showing esteem for a truly remarkable woman."

She was spared the awkwardness of composing a suitable answer by the arrival of Simon. He took his place at the table with every sign of discomfort at being so honored. Af-

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ter prayers had been said and a few pleasantries exchanged, he lapsed into silence and looked fixedly at the candle flames, as though fire itself was something new to him.

"Tell me," said Mesnil, as the meal progressed, "we hear so little of the world outside these days—how is my old friend Seroia?"

"Uncommonly well and in the best of spirits—but then I've seldom seen him otherwise. He's an incredible character."

"He is indeed! I recall I once asked Seroia what was his function as a consulting philosopher. He said that if a man was beset by green demons and took his problem to the church, a priest would pray for the sickness in his soul. If he took his problem to the doctor, a psychiatrist would probe for the sickness in his mind. But only a consulting philosopher would pick up a stick and help him chase the demons."

Marion Karp laughed. "I think there you have the essential Seroia. To him, all things are possible."

"Is it that which leads him to be involved with your present problem?"

"His appointment as head of the investigating body was the unanimous choice of several Governments—and I think they were right. We're faced with the task of locating an improbable genius who disseminates impossible physics for an inscrutable reason. I doubt if anyone in the world is better qualified to handle it than Seroia."

"But between ourselves, just what are the chances of finding this person?"

Marion Karp pursed her lips. "It's a question of intellectual stature. I see this now as a fight between two minds, Seroia's and that of our unknown genius. We know Seroia's potential, but we've no real measure of the other."

Abbé Mesnil leaned back. "I wonder if we really do know Seroia's potential. I remember he was playing with a theory that the sum-total of human knowledge, past, present and future, is already contained in the human mind. That what we think of as discovery is in reality only a triggered rediscovery of knowledge already inherent within us. This would go a great way to explain sudden leaps of inspiration which are subsequently proven to have great scientific truth."

"I've heard him speak of the idea, but I scarcely considered it seriously."

"I doubt if he spoke of it seriously. But you can't dismiss the idea too lightly. The idea of a metered release of knowledge into our expanding technology is well in accordance with the observed facts of scientific progress. But Seroia was interested in the trigger mechanism by which increments of this knowledge are released. He theorized that if one could gain conscious control of the trigger, then there would be almost no limits to the rate at which scientific progress could be made."

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"As a scientist," said Marion Karp, with a slight hint of disdain, "I can assure you that scientific progress depends on no such mumbo jumbo. There's not the slightest evidence in support of such a trigger mechanism."

"But there is!" said Mesnil reproachfully. "It's what you call scientific method. A fairly recent innovation, historically speaking, but it's a technique with all the hallmarks of a rapid-firing trigger mechanism. Currently it doubles the total of human knowledge every seven years. But think for how many hundreds of centuries human progress lay relatively static before its introduction."

She pretended to be cross. "Abbé Mesnil, this is nothing but a philosophic parlor game. You know perfectly well that the success of scientific method needs no such ridiculous explanation. It's a discipline, and like most other forms of discipline, it's designed to ensure a more efficient approach to a given task. As a leader of a disciplined Order, you must at least agree with that."

"Touché!" Mesnil grinned like a schoolboy caught in the midst of a prank. "It's a pity, my child, you could not be with us more often. It is rare in San Cherno to hear spirited dissension. Believe me, its effect is tonic. But I digress. I was on the point of saying that Seroia was looking at the possibility of the existence of an even faster trigger."

"Which he obviously didn't find."

"I don't know whether he found it or not. Seroia is a canny old bird at the best of times. But I'm tempted to wonder now if your genius does not have access to this kind of knowledge."

From somewhere in the monastery the long chime of a bell was a pulse marking the hours, days, the years and the centuries, yet itself remaining virtually unchanged. Beyond that, the silence of the night lay like a sullen sheet of lead, a heavy insulant separating San Cherno from the other kind of world which lay outside.

"I admit it's a possibility," said Marion Karp finally, but her voice lacked conviction. "However, it does nothing to solve the problem of identity. In fact, it makes the situation worse. From what we know at the moment the genius could be any of a wide range of gifted individuals. Even Seroia himself, or you, Abbé Mesnil—or Simon here. Genius need leave no outward traces. We've always assumed that he must be a trained research scientist, but if your theory was to hold true, then almost anyone on earth could qualify."

"Could not one approach the problem from the aspect of motivation. Such misuse of a God-given privilege is both an irresponsible and criminal act. Surely that gives you some clue to the type of character you're seeking?"

"Is it really criminal?" asked Marion Karp. "There's no crime in writ-

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ing letters to fools, even if the fools destroy themselves in their eagerness to use what they've failed to understand."

"It's a moral crime to give a lethal weapon to a child," said Mesnil quietly.

Something in his voice caused her to look at him quickly, but the old eyes reflected only the dancing flames, and the old face reflected only the deep lines of a lifetime's thinking.

"I'm not sure that I agree with your simile, Abbé Mesnil," she said, changing the subject with a slight hint of impatience. "But if you'll permit, there are still a few questions I'd like to put to Simon. There are some peculiarities about the Gratz blowup which need more explanation. Simon, I understood you to say the reaction had no heat of its own. It should have had—must have had. Surely your instrumentation was at fault?"

"Madam, there was no heat. There were a dozen monitors at the post, all recently calibrated and all reading true ambient. Not one of them recorded the slightest deviation during the blowup. Besides which, I was there at the edge of the desert. If there had been heat I would have felt it."

"But the sand . . ."

"The sand was fused by molecular, not thermal action."

"And I tell you that's impossible."

"Since the reaction was of a type unknown, my child, I'm intrigued to know why you think it ought to have been otherwise? How do you determine the impossibilities in an impossible event?" Mesnil's intercession was soft but shrewd.

"Certain things are predictable, given the basic principles, Abbé. I've spent all afternoon trying to understand the thermodynamics of a theoretical model of the reaction."

"But why, Madam?" Simon turned and looked at her with some surprise. "There were no thermodynamic considerations involved."

"You must be mistaken, Simon. In that class of reaction they can't be avoided." A hint of annoyance sharpened her voice.

"Excuse me, Madam! You have had those equations for a few hours only. I worked with them for eleven months. From them I forged the working hypothesis from which Ornado built his test device. With respect, I submit it is you who have failed to comprehend." His dark eyes glowed with the earnestness of his conviction.

"Then you're either not the mathematician you've been acclaimed to be—or else you're hiding something. I suspect the latter, Simon, because the letter you gave to me was not the original letter received." Her voice was hard and full of steel, like the closing of a trap. "What do you answer to that?"

Simon looked back again to the white flames of the candle.

"What can I say—except that God is my witness."

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"Permit me to intrude, my child," said Mesnil gently. "I'm afraid you've both been victims of a slight deception. The letter which Simon gave to you was not the original. But Simon knew nothing of the substitution—and you could not have known it either, Madam Karp. Except that you wrote the original yourself."

"What's this!" Marion Anderson Karp spun like a tiger to face Abbé Mesnil, her anger causing her to half rise from the chair.

Mesnil retained his eternal calm, and put his long fingers gently on her hand.

"Peace, my child! There is nowhere you can go, and nothing you can do. So please relax and take wine with us. It's a pity to spoil our day of exceptions."

"I don't want your damned wine! You know you can't substantiate your accusation."

"I can, Madam Karp, because you walked into a carefully baited tap. The original letter—your letter—was brought to me by Ornado, to whom I have long been mentor and comforter. As with all things I find beyond my ken, I sent the letter to Seroia. He sent back a similar letter and asked us to use it as though it were the original. It was Seroia's reaction which fused the sands at Gratz yet had no heat of its own."

"So that's why there was no thermal radiation?" An angry comprehension lit her face.

"Just so, my child! But you found the point significant, thus betraying a prior knowledge of what the reaction was initially designed to be. You stand condemned out of your own mouth. Seroia suspected you—but left to me the task of establishing the proof. And that is how you find a genius who has a genius for remaining undetected. You turn such cleverness back upon itself."

The anger drained from her face to leave a residue of helplessness. Slowly she slipped back into her chair. A rueful smile played at her lips as she watched the abbé fill her glass.

"So Seroia wins after all! You realize, of course, that to produce that cold reaction at Gratz means that Seroia has access to knowledge far in excess of anything I attained?"

"Was that what you were trying to prove—that you had the best brain in the world—of greater stature even than Seroia?"

"In a way, I suppose . . ."

"Then you were lost from the start, my child. Stature is as much dependent on quality as on magnitude. Seroia has one quality which you have yet to gain—maturity. What knowledge Seroia has, I do not know, nor is it important. He uses his prowess kindly and wisely. He would never give a loaded weapon to a child."

"What will become of me now?"

"That you must ask Seroia when he comes. He said something about the time being right to teach you the art of chasing demons instead of being one." ■

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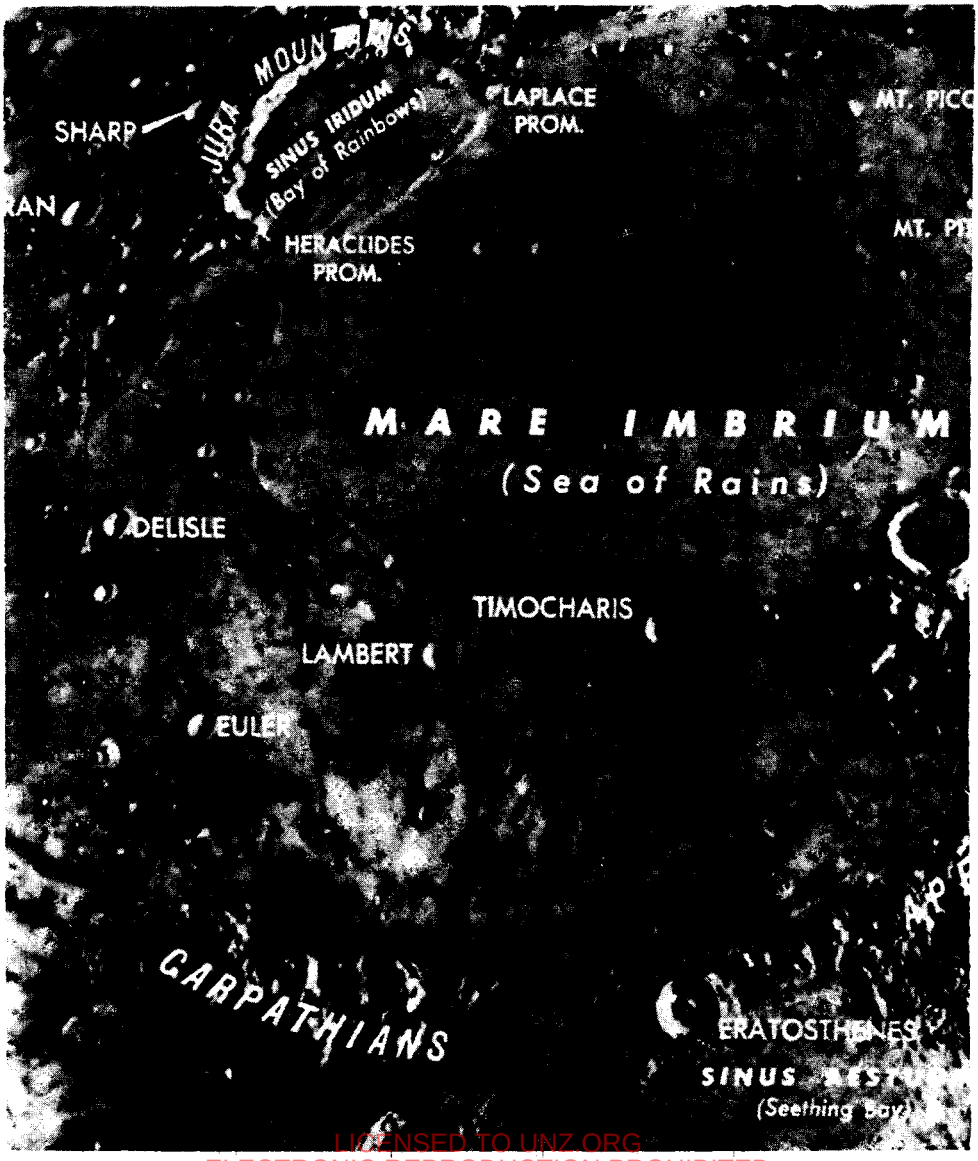
NILS AALL BARRICELLI



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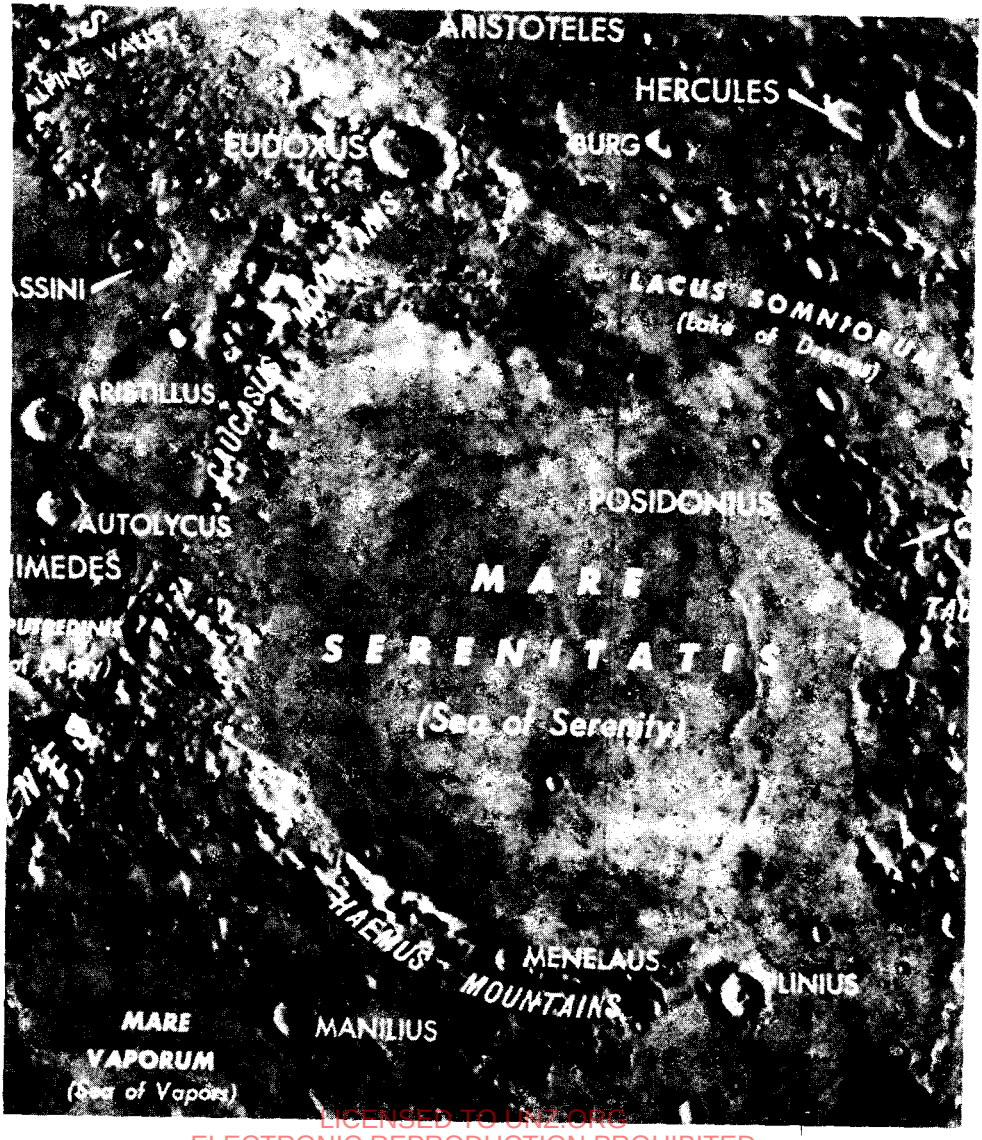
The Imbrium Impact

That the Moon has been the target of enormous meteor impacts has been recognized for some time. Only with the coming of the great computers has it been possible to analyze exactly what must have happened. This work, done in Sweden, indicates the impacting bodies weren't asteroids—but Earth's other moons!



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On any good map or photograph of the Moon one finds several extended smooth areas of a darker color than the rest of the lunar surface. These are the so-called maria, or seas, which are believed to be extensions of solidified lava. The rocks brought back by the Apollo 11 astronauts lend support to this interpretation of the nature of lunar maria. Several of the maria—among them some of the most prominent are Crisium, Serenitatis and Imbrium—have a rounded shape strongly reminiscent of impact areas by sizable celestial bodies. Smaller impact areas which present the same smooth and darkly colored surface are the craters Plato, Archimedes, Ptolemaeus, Billy, Crüger, Grimaldi and several others.

The origin of the lava, which filled these presumed impact areas, has for a long time been a matter of scientific dispute. One of the oldest theories, which until recently has been finding wide support, holds that the lava is of volcanic, or internal, origin. Another theory, which has been prominent since Gilbert presented it in 1893, ascribes the lava formation to heat generated by the impacts in which the respective maria and craters were created. For the production of large quantities of lava the velocity of the colliding object would have to be within a narrow range of 2 to 3 km./sec. A question to be clarified is whether and how this kind of velocity is possible in a lunar impact.

Satellite and Meteor Impacts

The way in which some of the lunar surface features were formed appears easier to understand if one distinguishes between satellite impacts and meteor impacts. The former are due to collisions involving objects in orbit around the Earth, while the latter are due to collisions involving objects which are not Earth satellites, such as meteors and comets. The velocity and energy generated in a satellite impact has long been known to be primarily created through the acceleration of the impact object by the Moon's gravitational field, a fact repeatedly verified also by data-machine trials. This means that the collision velocity of a satellite impact is usually close to the lunar escape velocity of 2.4 km./sec., which is well within the range of 2 to 3 km./sec. mentioned above in which large quantities of lava can be produced. On the other hand, the meteor impact velocity, is often in the same range as the Earth's and Moon's orbital velocity in their movement around the Sun, or ca. 30 km/sec. This is one order of magnitude greater than the lunar escape velocity. The energies and temperatures generated are proportional to the square of the impact velocity. Temperatures above 100,000 degrees Kelvin can easily arise in a meteor impact and the energy generated during such impacts is usually sufficient to vaporize a substantial portion of the material involved in the collision, causing an explosion and creating a saucer-shaped crater sim-

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TABLE 1

Velocities and energies (in calories per gram) of typical meteor and satellite impacts, compared with melting and volatilization energies for silicates.

	VELOCITY KM/SEC	ENERGY CAL/GR	TEMPERATURE CENTIGRADE
TYPICAL METEOR IMPACT Comparable to Earth's (and Moon's) orbital velocity.	30	100,800*	
TYPICAL SATELLITE IMPACT Comparable to the Moon's escape velocity.	2.4	690**	
NEEDED FOR MELTING SILICATES**		450	1250°
NEEDED FOR VOLATILIZATION OF SILICATES AND FOR THE CHEMICAL REACTIONS INVOLVED**	>800	2200°	

**Calorie equivalent of the object's cinetic energy.*

***Silicates represent a major component of lunar material, and may also have represented a major component of the other satellites of Earth.*

ilar to the large meteor craters on Earth—Marshall, 1943. On the other hand, although the energy and temperatures generated during a *satellite impact* are usually sufficient to smelt part of the material involved in the collision, they are insufficient to vaporize a significant quantity of the material.

Thus, lunar surface structures caused by satellite impacts tend to present a dark, smooth, horizontal surface indicating the production of large amounts of lava, while those caused by the meteor impacts give evidence of a violent explosion in which most of the material was vaporized, leaving behind comparatively much less lava. An effect of the explosion is to cancel any possible trace of the inclination with which the meteor reached the lunar surface. Meteor craters, therefore, will have the same saucer-shape appearance irrespective of the impacting angle. Not necessarily so in the satellite impact areas, which occasionally may retain traces of the inclination and direction from which the impacting object reaches the lunar surface. This is particularly evident in the case of the Imbrium im-

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pact which will be our main interest.

Following these criteria the impact maria and those craters, which present the same smooth darkly colored surface characteristic of maria, have been ascribed to collisions with smaller satellites that may have been in orbit around the Earth in the early days of our satellite system. On the other hand, the more typical saucer-shaped lunar craters are ascribed to the violent explosions which would result from collisions with the much faster objects, like meteors and small planets, that were not part of the Earth's satellite system.

We shall present here one of the main points of major interest in the impact theory, namely the interpretation of several prominent features and characteristics of the Mare Imbrium and surrounding areas.

The Mare Imbrium Region

The Mare Imbrium is the largest of the circular maria. It is easily visible in the northern—upper in Europe and North America—hemisphere, a little to the left of the central meridian, on a binocular or even by naked eye. On a good map or photograph (see Page 68) one can notice two distinct areas inside this mare: (1) A central roughly circular area which is very smooth except for a few comparatively small craters due to late impacts which occurred after the lava was solidified. (2) A horseshoe shaped border area nearly surrounding the central part from all sides, except the northwestern sector, with much greater crater density and containing several mountains and large craters notably Archimedes, Aristillus, the Lower Apennine Highlands, the Teneriffe Mountains, and several others.

The smooth central area has a diameter of roughly 700 km., while the diameter of the whole Mare Imbrium is roughly 1,100 km. The size of the mare, the asymmetric shape of the horseshoe border area and the other characteristics of the whole region which will be described below, have led to the following interpretation of the events which may have shaped this remarkable feature of the lunar surface. Probably between 3.5 and 4 billion years ago one of the early satellites of Earth—which we may call "The Imbrium Satellite"—collided with the Moon after approaching its surface from a low angle to the horizon. The main body of the satellite approached the lunar surface moving from a northwesterly toward a southeasterly direction and reached the Moon either in the Sinus Iridium—according to Urey—or a couple hundred kilometers farther to the southeast, nearer the center of the smooth circular area—according to Gilbert's and the author's interpretations.

The Impact

The Imbrium satellite must have been the largest—or one of the largest—satellite that ever collided with the Moon. Its diameter may have been as large as 300 to 350 km. Be-

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fore reaching the lunar surface several fragments may have been separated from the main body of the satellite by the gravitational pull of the Moon, after the satellite entered the Roche limit.* Many more smaller fragments may have been formed after the satellite strafed the lunar surface in its nearly horizontal path. The impact of this satellite must have been a spectacular show.

First, a major fragment of the satellite may have reached the Sinus Iridium producing a crater of about 210 km. in diameter. After one or two minutes the main body of the satellite—or its main fragments—may have reached the lunar surface one or two hundred kilometers farther to the southeast, between the Sinus Iridium and the center of the circular smooth area already described. The temperature produced by the impact was not by far as high as the temperature—often several hundred thousands of degrees centigrade—produced by major meteors. This is because the velocity of an Earth satellite colliding with the Moon is unlikely to be much higher than 2.4 km./sec.—the Moon's escape velocity. Probably the highest temperatures did not exceed 2,000 degrees centigrade. But the phenomenon was nonetheless most spectacular.

Within minutes a roughly circular area with a diameter of about 700 km. was smelted. The shock wave produced by the impact had also demolished almost completely the surrounding horseshoe border area of the Mare Imbrium and was proceeding to farther distances generating what may probably have been the most gigantic Moon-quake in history. After the shock wave several kilometers high waves of lava originated in the molten part of the Mare Imbrium and completed the destruction of the horseshoe border area. A portion of the lava may have crossed the mountains to the north and flooded the regions behind, thus forming the Mare Frigoris and the Sinus Roris. A portion of the Oceanus Procellarum may also have been flooded on this occasion. At the same time a gigantic shower, of various sized fragments of the Imbrium satellite, was reaching the lunar surface. The main stream of these fragments was moving, like the Imbrium satellite from northwesterly to southeasterly direction.

A large region to the southeast of the Mare Imbrium, and particularly the Haemus mountains, shows clear signs of having been deformed and reshaped by the gigantic stream of solid fragments, as can be seen on Page 68. The whole region presents the most startling testimony of the gigantic storm which followed the Imbrium impact as pointed out by Gilbert, Urey and others. Some of the largest fragments produced the craters in the horseshoe border area

*The Roche limit is a distance from the center of a planet, or satellite, corresponding to approximately 2.3 planetary or satellite radii. Objects within this distance tend to be broken up by the gravitational field of the planet or satellite into smaller fragments. This concept is used among others in the theory of the formation of the rings around Saturn.

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which have already been mentioned, and many of the craters which have apparently the same age and are spread in a large region to the south-east of the Imbrium and the Haemus mountains, such as the craters Conou, Manilius, Menelaus, Plinius, Ross and Arago. Some of the fragments may have reached the horse-shoe border area in the brief interval between the shock wave and the following waves of molten lava, producing ghost craters like Wallace and possibly Cassini (see Page 68).

Lunar Spin After the Impact

Most of the facts presented above have been known since Gilbert presented the satellite impact theory in 1893. Nevertheless the fact, that a satellite the size of Imbrium reaching the lunar surface on a nearly horizontal path at a velocity of roughly 2.4 km./sec. would almost certainly have left the Moon spinning with a significant velocity, is one which has long escaped our attention. The mass of the Imbrium satellite is estimated to have been at least 1/1000 of the Moon's own mass. If the Moon had been at rest at the time of the impact, its rotation period after the impact would have been less than thirty days. This amount of spin would be quite sufficient to bring the Moon out of its bound rotation to the Earth today, and would almost certainly have been sufficient to do the same at the time the collision occurred—see Barricelli and Metcalf 1969. Only after the problem of explaining the distribution of maria on the lunar surface, and particularly their nearly total absence on the far side of the Moon arose as a major issue, attention was focused on the possibility that the face of the Moon, which today faces the Earth, at one time may have been the far side of the Moon.

Together with R. Metcalf, the author of this article had undertaken the task of investigating whether the asymmetric distribution of maria could be explained by the following facts:

1. The Moon's distance from the Earth is known to have been increasing steadily as a result of the tides effect. Between 4 and 4.5 billion years ago the Moon may have been very close to the Earth's surface and perhaps barely outside of the Roche limit.
2. Under these conditions the Moon could only collide with satellites in orbits external to the Moon itself since it is well-known that any sizable satellite inside the Roche limit would rapidly disintegrate into some kind of saturnic ring.

This theory can explain the fact that the Earth has no other satellites today, since earlier satellites would either have collided with or have been deviated by the Moon as its distance from the Earth increased. Even if the Earth had some kind of saturnic rings, they would have been perturbated and demolished as the various fragments in each ring successively came into resonance

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with the receding Moon. We undertook the task of investigating by a data processing machine the orbits of a large number of external satellites colliding with the Moon under various conditions. The purpose of our investigation was to find out whether collisions with satellites in external orbits would present an asymmetric distribution on the lunar surface matching the observed distribution of maria. Our findings showed that it would and that the match would be almost perfect if the side of the Moon presently facing the Earth had been the far side of the Moon when the impacts, which created the maria, occurred.

This brought our attention to the fact that collisions, and particularly a collision with a satellite following a nearly horizontal path like the Imbrium collision, might spin the Moon around. Our attention was focused on the Imbrium which is also the largest single impact that can be seen on the Moon and—as pointed out by Urey—is probably also the latest major satellite impact—possibly with the exception of the Mare Orientale whose nature satellite, or meteor impact, is not established with certainty. This led us to recognize the various conditions indicating that the Moon may have been left spinning at an appreciable speed after the impact. None of the other maria present such good evidence that the respective collisions would have disengaged the Moon from its Earthbound rotation.

Earth's Early Satellite System

Our present interpretation of the events leading to the formation of the maria can be summarized as follows:

In the early days of the satellite system, probably around 4.5 billion years ago, several moons of different sizes rotated in the Earth's equatorial plane. The innermost was the largest, and its distance from the Earth was gradually increasing. At a greater distance several other moons, among them the three which originated the maria: Crisium, Serenitatis and Imbrium, rotated in different planes with different inclinations. As the largest moon's distance from the Earth gradually increased it collided first with several of the moons in the equatorial plane. These bodies must have reached the surface of what at that time was the far side of the Moon near the equator, thus creating most equatorial maria like Tranquillitatis, Foecunditatis, and many others. The most recent impacts such as Serenetatis and Imbrium occurred at a greater distance from the equator because of the greater inclinations of external satellites in our system as in all other major satellite systems. The last major collision was the Imbrium impact which left the Moon spinning probably for several thousands, or even millions, of years. When the Moon's Earth-bound rotation was eventually reestablished, the original far side of the Moon and the side originally facing the Earth had been interchanged. This interchanging

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was made possible by the ellipsoidal symmetry of the Moon which allows two equally stable equilibrium configurations.

This is, according to the impact theory as far as we can tell today, the most likely succession of events which may have led to the present shape and distribution of maria on the lunar surface.

Impact Generated Temporary Atmosphere

The heat generated in a major impact, such as the Imbrium impact, might cause the formation of considerable amounts of carbon dioxide and other gases escaping from lava and overheated material, thus temporarily supplying the Moon with a thin atmosphere. Within a few thousand years most of the atmosphere may have escaped from the Moon, whose gravitational field is incapable of retaining the main atmospheric gases for a long time. A minor portion of this atmosphere may, however, still be on the Moon in a frozen condition in the southern and northern polar regions on the bottom of deep valleys and craters which never are reached by the sun. Temperatures approaching absolute zero may prevail in those places where solar heating is never available to replace the energy lost by irradiation into space. Any kind of common atmospheric gases could remain in these places in a frozen condition for an indefinite length of time. Not only carbon dioxide, but possibly even hydrogen compounds like water, ammonia and methane might be found in a frozen condition in a few places around the polar regions. The solar wind and impacts by comets might have supplied the hydrogen.

Deposits of frozen gases might prove highly valuable in the future, not only for the supply of oxygen and water for human settlements, but also as a source of rocket fuels. The transportation of spacecraft fuels from Earth is extremely expensive, and it is quite conceivable that the first mining industry on the Moon might be aimed at the production of fuels for interplanetary travel. But apart from this possibility an exploration of one of the oldest deep craters in a polar region of the Moon would, in its own right, be worth considering as a possible target—for an Apollo expedition for its purely scientific interest. Few things could bring more light on the past history of the Moon than the discovery of frozen gases deposited at various times since the Moon was formed. Unfortunately old deposits of frozen gases might be covered by a deep layer of dust from meteoric impacts and inaccessible to astronauts with their present equipment. However, nobody knows what there is to be found before some of the coolest spots on the lunar surface have been visited. One certainly can not take it for granted that the surface composition in such places would not be quite different from the rest of the Moon. ■

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G. HARRY STINE

Does the circuit have two wires, or one? Does the electron know which way it's going when it goes two ways simultaneously? But whichever way it goes, the physicist has achieved the hitherto known to be impossible—a noninductive resistor!

topological electronics

Ever since the German mathematician Möbius first studied the topological phenomenon of the two-dimensional, one-sided surface that now bears his name, the Möbius strip has been a fascinating and somewhat baffling conversation piece and mathematical curiosity. It can be easily fabricated by anyone, mathematician or idiot, who has a piece of paper, a pair of scissors, and some sticky tape. Just cut a strip of paper, bend the two ends around to each other as though you were making a paper ring, twist one end of the strip 180-degrees, and then tape the two ends together. As nearly every grade-school mathematician knows, the resulting century-old concept of the Möbius strip has only one side and one edge—a two-dimensional anomaly in a three-dimensional universe.

The Möbius strip remained a curiosity until R. L. Davis at Sandia Laboratories in Albuquerque, New Mexico, began working on ways to make nonreactive resistance units. Davis wanted very low resistances and very low reactances. It's very difficult to make a pure resistance unit that also has very low capacitive reactance as well as very low inductive reactance. Our three-dimensional universe just doesn't normally permit it.

But Davis thought of the Möbius strip. Obviously, if you can't make a nonreactive resistor in three-dimensional space, you can make one in two-dimensional space!

To make his first Möbius resistor, Davis laid aluminum tape conductor on a strip of masking tape. Two strips of aluminum tape of equal length were used. The opposite ends of the conductors were soldered together opposite each other for the resistor's terminals.

This first Möbius resistor had a 0.022-ohm resistance and a residual reactance of 0.003 microhenries! As a result, its time constant was 1.3×10^{-7} seconds, which is very low for

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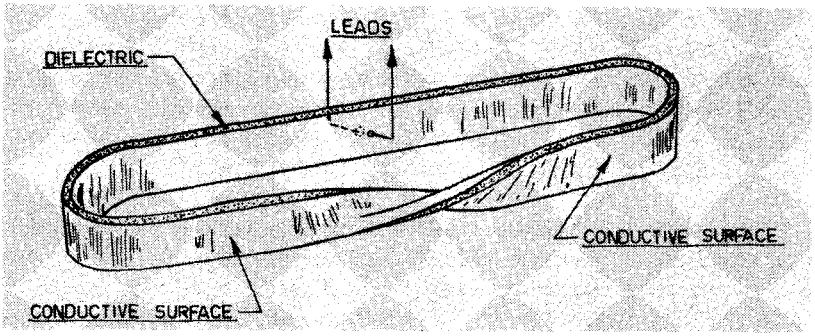
such a low value of resistance.

Immediately, other Möbius resistors were made using various dielectrics, lengths, and bifilar wire in addition to tape. Resistances as high as 80 ohms were made having exceedingly low reactances that had to be measured in terms of fractions of microhenries and picofarads.

The Möbius resistor exhibited some very interesting features right off the bat. For one, it wouldn't couple to other metallic objects or to itself! Hooked into a measuring bridge, the Möbius resistor could be handled or changed in form without disturbing the bridge.

Davis also made two resistors lying parallel on the same Möbius surface and separated by 1/16". The two resistors completely ignore each other, regardless of the way they are hooked up—series or parallel! And the residual reactances obey the same rules of inductance coils having no mutual coupling. Thus, Möbius resistors can be connected in either series or parallel to vary resistance values without changing the time constant from that of a single unit.

The actions of a Möbius resistor on a pulse are fascinating to contemplate. When the pulse enters the Möbius resistor at the terminals, it splits into two equal pulses because the impedance is identical in both directions . . . except that one is right-handed and the other is left-handed, so to speak, with respect to the direction of their energy and magnetic vectors. Therefore, they



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can effectively pass right through each other and do not interfere or cancel each other as they proceed around the Möbius strip and back to the terminals. The differential equation that describes this activity has two solutions, but for ordinary geometrics in resistors only one solution is used. This caused a bit of confusion at first when attempts were made to understand what was happening to the pulses in the Möbius strip.

(If the investigators were confused, how about the electrons?)

This fascinating application of topology to electronics—or electronics to topology, if you will, because topologically it may not make any difference—has been granted a U.S. patent, which is also fascinating reading! ■

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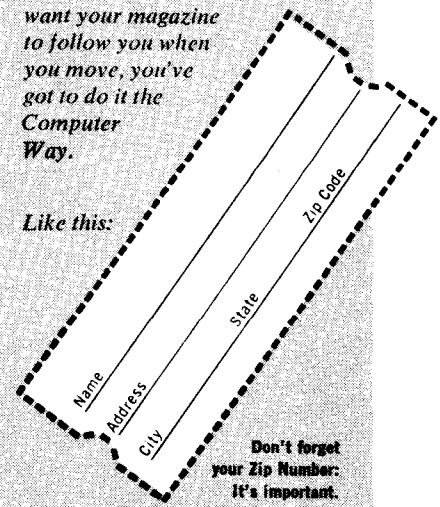

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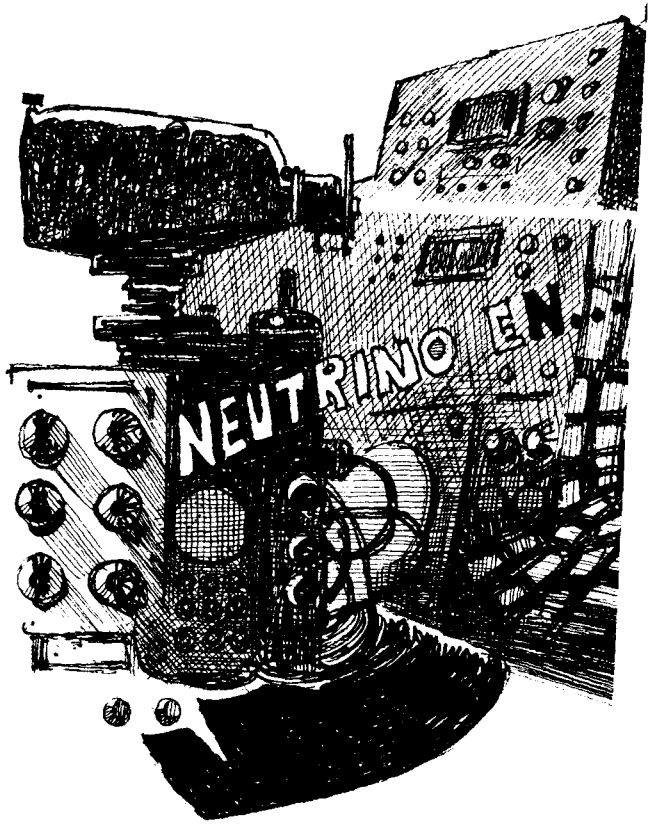
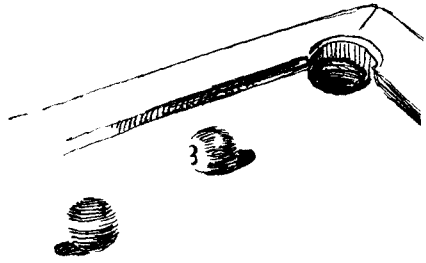
analog

The trouble with a human-model computer is that the program is so complex it takes years to work out . . .

GRANT D. CALLIN

ILLUSTRATED BY LEO SUMMERS





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PROLOG: CATALOG

The Director of Research of the Library of Congress was a good computer man in his younger days, but his real flair was for politicking; he had climbed up the civil service ladder with relative ease to his present post, and promised to go further. Nevertheless, he kept up with the literature of his old field, and he still retained a sweeping imagination.

The man facing him across the desk was his opposite in many respects—brilliant researcher, Huxley Laureate in neurophysiology, and entirely out of his element in the nation's capital. But he, too, was a man of imagination, and had been a friend of the director since their college days. At the moment his fair features were screwed up in mild puzzlement; he was wondering why the director had called him down from the Federation meetings at Atlantic City, apparently to expound on the elementary principles of library information dissemination.

". . . Essence, the catalog is simplicity in itself, which you know, Hank. Every time an author submits a scientific paper for publication, he's required to place it in one of our 8,400 main categories, in at least one sub and three sub-subs, and is further encouraged to fit it into as many more as he can. Then when a researcher wants to explore the literature with respect to a particular type of experiment or technique, he simply contacts one of our thousand or so outlets and requests a printout of the categories in which he's interested. A beautiful system, right?"

"Well . . ."

"Exactly: it stinks and we both know it. There's a frightening loss of information in the semantic chain involved. And frankly, it's getting worse all the time with 5,000 titles a day coming in, and the rate accelerating. Last spring at the LS conference Shalot showed by statistical sampling that the rate of needless experimental duplication is up to ten percent, and will increase during the next generation to almost forty percent before it begins to level off." He switched his tone of voice. "When's the last time you used the LC computer for researching a piece of work you wanted to do?"

The neurophysiologist hunched his small body up on the edge of the chair, and thought for a moment. "Let's see, it was about three years ago. I wanted to find out what had been done in the way of using IR microlasers for selective destruction of cortical motoneurones. I went into the computer with 'Microlasers,' sub 'Infrared,' sub-sub 'Biological uses of,' which was as close as I could get." He smiled ruefully. "The printout was a list of fourteen hundred-odd articles, twenty-seven books, and seven monographs; and after half a month of weeding, I finally got down to five articles which were of some value. Guess I was lucky at that; my research fell into only one possible sub-sub."

"Don't kid yourself, my friend.

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The catalog system runs on Finagle's Second Law; odds are a hundred to one that, buried somewhere in the other half a million sub-subs, there were at least ten more titles of direct interest. Which brings me to the next point. What're we gonna do about it?"

"Well . . ."

"Never mind. The library science people have beat their heads against that wall for years. They say that a really good system is impossible, and that it would cost about half a GNP to come up with even a mildly significant improvement. Let me ask you something else instead: postulating that he could take in all the information somehow, could a man with total recall hold all the facts now in the Library of Congress?"

"Easily. He wouldn't begin to strain."

"And if I were to ask him about possible new techniques in underwater basket-weaving, would he be able to tell me to look at Whatsitsname's paper on the art of liver surgery because of its discussion of sewing in a viscous medium?"

"If he were reasonably intelligent, and trained in cross-correlation techniques, yes."

"Hah! In that case, Dr. Henry D. Hoffman, I have a proposal to make: let's build a computer for this library which duplicates—at a much higher speed—the associative processes of the human mind, and thereby completely eliminate the semantic gap!"

The neurophysiologist caused his face to go amusedly wry. "Don't forget to implant the three laws of robotics."

"Huh?"

"Oh, come off it, Bob. You've been hung up on Asimov's stories ever since we took that course in Classics of SF together twenty years ago."

The director blushed, but held his ground. "The time to do this thing must come eventually. Why not now? How many neural synapses in the human brain—somewhere around ten billion?"

"No, that's the number of neurons. The number of synapses is more like 10^{13}."

"Even so, with the new self-breeding circuits Bell developed a couple of years ago a specialized computer with 10^{13} bits is not only feasible, but the core and its talk circuits could fit into the bathroom of an average-sized condom. What's the sweat?"

Hoffman smiled gently, "Bob, the human brain is not a digital logic machine. It's an analog device with probably thousands, possibly millions, of action potentials generated to form one small thought-chain."

"So? Digital analog simulation has been around for decades."

"Yes, but to duplicate higher brain function by sequential logic processes would probably take too long for what you have in mind. I don't think we could use a DAS any faster than about ten or twenty times biological speed."

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"Hm-m-m . . . what kind of fast-memory core you got in your lab?"

"A Packard-Bell 6240."

"Let's see . . . that means your machine takes about a tenth of a microsec to go in and grab a bite from core. No wonder you're biased; you have the old wafer/cube system. Fast enough for most work, and dirt cheap, but it can't hold a candle to the new five-molecule layer stuff. Hell, man, the biggest lag in that system is the wiring length; time through a gate is of the order of that of a few electrons jumping orbitals. Core conversation time is determined strictly by the 'nanosec-a-foot' rule. So we can get speeds about fifty times those you're used to, and if that's not enough we can use parallel operation; cores are cheap. Besides," he finished confidently, "we don't want to duplicate the whole brain, just the part that does the coding and association of incoming information."

Hoffman laughed. "Bob, you just encompassed not only the whole brain, but the entire afferent and much of the efferent nervous system, including all the spinal ganglia and the twelve cranial nerves."

"I did?"

"You did. Information coming from any one of the thirty-odd senses is coded logarithmically almost right at the site of stimulation; it's re-coded at the spine according to a power function. And then, depending on the input pathway, it's re-coded again and again and mixed with other signals—including feedback from commands going out to the periphery—all before it ever gets to the brain! Most information reaching as high as the brainstem appears diffused and garbled almost beyond our comprehension. And virtually all neurons in the higher centers are laced up with hundreds or thousands of synaptic boutons, none of which is capable of independently firing the cell; the brain is really an enormous collection of coincidence detectors.

"In fact, current theory has it that the process of 'thinking' involves largely the raising and lowering of neuronal tone, and that it evolved from anticipating and changing acts about to be performed reflexly. Which is beside the point. Fact is, what you're asking your computer to do is duplicate coding which is constantly occurring at a huge number of sites over a vast network. Would you be willing to undertake a task of that magnitude?"

"Yes. Even if it took twenty years, it would be worth it."

"I agree, but your estimate is not even of the right order of magnitude. Now, I admit that I've complicated the picture a little for dramatic effect; with present knowledge of transmitter action, receptor sites, and nerve fiber geometry, we could probably build a decent analog of any neural pathway. But to know absolutely that we'd duplicate the associative powers of the human brain, we'd have to build an exact ana-

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tomical analog of an entire nervous system down to the spinal level." Hoffman began tapping his finger on the director's desk to emphasize his points. "All those stories you read about throwing a bunch of 'synapse circuits' together and creating a super-brain are poppycock.

"Anyway, with present slice-and-trace techniques a person can build a full model of a single neuron in about two working weeks. Now assuming that we could do this for each cell in the brainstem without destroying any of the others, we come to the depressing conclusion that the time required for the task would come to four or five hundred million man-years!"

The director held up his hand, a frown coming to his face. "Please! You sound like a conservative editorial of some kind. The people who developed WiBAViS solved that class of problem over ten years ago."

"Hm-m-m . . . wiring by automatic visual scanning? I never thought of that; those systems are so expensive only the government can afford them. I've never seen one in operation."

"You should. It's an education. Say, don't you remember those two guys about five years ago that used a WiBAViS to build an electric analog of a monkey's kidney? And they did it pretty fast, too, using laser-sliced electron microscope slides. The job only took 'em a couple of weeks, once they got the programming done."

"Yes, I do remember, now that you mention it." Hoffman's face was beginning to light up a little. "It was Ross and Barney, at the Mayo Clinic. And the model worked pretty well, as I recall. Hm-m-m . . ." A look of speculation began to dominate his face; he began muttering sub-audibly, oblivious to his friend for the moment.

The director smiled to himself; he'd finally got Hoffman thinking seriously about the problem. The bright fall day drew his eyes toward the window, where he saw the denuded cherry trees silhouetted against the bay. They brought to his mind a row of inverted organizational charts, lacking only the neat labels at the branch tips to tag the departmental levels . . . He focused his ears as the neurophysiologist began talking again.

". . . Suming that WiBAViS is sophisticated enough to handle the job—"

"It is, believe me. All you need is an imaginative programmer."

"Well, assuming that, anyway, there's still one insurmountable difficulty. Neurons exhibit two types of activity, depending on the type of synapse: either excitatory or inhibitory. Now when the brain is alive, we can differentiate between these two types by a slight variation of the anatomical geometry; but when we preserve a brain for detailed study, our perfusions also destroy this dif-

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ferentiation. And, of course, anything like X-ray holography is out of the question; it would certainly destroy any live brain on which we used it extensively."

The director frowned a moment, as if trying to remember something, then suddenly began to laugh.

"What's so funny?"

"Y'know, Hank, I got so wrapped up in arguing this project from the computer standpoint I completely forgot what gave me the idea in the first place!" He walked to his bookshelf, pulled out the latest edition of *Scientific American*. "Read this yet?"

"No. My copy must have arrived after I left for the Federation meetings."

"Take a look at the cover story."

He handed the magazine to Hoffman. On the front was a picture of a multitude of tiny units composed of triple spheres; its caption read: "Water Molecules Frozen in Their Thermal Dance." The story was entitled "Neutrino 'Holograms' Defy Heisenberg Uncertainty." Without a word, Hoffman thumbed slowly through the article, stopping from time to time to read a paragraph and mutter to himself. Finally he looked up and spoke, his eyes beginning to fill with wonder. "Why, this instrument could scan a live brain without destroying a single cell. It just might be possible. It just might."

The director reached for his phone, punched a number.

"Hi, Carol, this is Bob Macpherson. The boss in? O.K., I'll wait." He turned his attention back to the neurophysiologist. "If you were going to attempt a project like this, how much time and money do you think you'd need?"

Hoffman suddenly had a suspicion that the conversation was getting out of control. He replied slowly; "Oh, I don't know . . . maybe about four or five years. But I'm sure the money's out of sight. Probably over 500 megabucks, not even counting the neutrino—"

"Hello, Glenn? BobbyMac. Remember the idea we talked about Thursday night? . . . Yeah. Well, I've got him here now, and he thinks he can do it—"

Hoffman panicked. "Hey, wait a minute; I didn't say—"

Macpherson shushed him with an impatient hand, continued talking; "Right. About a five-year gigabuck . . . Uh-hunh, yeah . . . O.K., I'll take your word for it, and we'll get started on this end right away. . . . Sure . . . Thanks a lot, buddy. See you tomorrow at the CC. . . . 12:30, right. Bye."

Hoffman was dumbfounded at the acceleration of events; he was certain that the person to whom the director was talking was Glenn Johnson, the Cabinet Secretary for Research and Technology. He finally found his voice after Macpherson disconnected:

"Hold on now, Bob; all we've done is speculate. There're thousands of smaller problems I haven't even touched on—and any one of

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them could invalidate everything I just said. And where am I going to find a CS man willing to undertake the computer development? And how do we know this Meneely-or-whatever-his-name-is will be willing to loan us this neutrino thing and show us how to use it? Damn it, I haven't even told you *I'd* do it. I've got my own job at the University, research projects of my own—"

"Nonsense. Of course you'll do it. And you'll solve the problems, too. Man, this'll probably be the biggest thing since Armstrong's 'one small step.' Leave that snug little academic life behind; I'll even let you pick the location of your lab."

"Well, I don't know; I'd still have to break my contract with the University, and if they got nasty they could stick me for a stiff—"

"I'll give you a flat salary of two megabucks, and all the spending money you want for equipment and hiring."

Hoffman grinned. "Sounds like fun. You have someone in mind to do the computer work?"

"Hm-m-m . . . tell you what. Let me make one phone call, then we'll go to dinner and talk about it."

As the director finished up his business for the day, the neurophysiologist gazed idly out the window. The naked cherry trees brought a vivid picture to mind: a row of Purkinje cells, with their dendrites standing up into the cerebellar cortex . . .

INTERLOG: BIOLOG

Dr. Henry Daniel Hoffman approached the office of Dr. Clinton Tucker Meneely with some trepidation. He'd never even talked to the man personally; all his explanations and appointment-making had been done by correspondence, and phone conversations with a secretary. From what he could gather, Meneely was something of a social and professional recluse; his attitude toward the project had been totally noncommittal. Finally—and this was something Hoffman didn't realize on a conscious level—he held the bio-science man's indefinable feeling of awe toward the hard-core physicist.

He walked into the office, and was awarded a polite "Yes?" by the secretary.

"I'm Dr. Hoffman. I believe Dr. Meneely is expecting me."

"Oh, yes, certainly, sir. He's in the lab across the hall; please go right in."

He thanked the girl, stepped quickly across the hall, and opened the opaque plastic door to the physicist's laboratory.

Inside, his eyes were overwhelmed by a shambles of oscilloscopes, commercial and home-built lasers, recording gear of all descriptions, and literally tons of equipment he didn't recognize at all. From somewhere to his left he heard a muttering, and simultaneously became aware of the odor of burning resin-core solder. He carefully picked his way towards the sound/smell,

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coughing loudly to advertise his presence.

Abruptly the muttering stopped. From behind a bench popped a head, then neck, shoulders, torso in distinct jerks, as if there were sequential time delays for each part of the body to realize the presence of a stranger. Finally the man had straightened out and stood, continuing to stare at Hoffman for a full five seconds. During that uneasy silence, Hoffman burned the physicist into his memory. Meneely was tall and rangy, with narrow face and unkempt hair; but dominating his appearance was a pair of extraordinarily thick glasses in which the neurophysiologist could see only the reflection of the overhead glow-panels. He had time for one wild thought—*must be too thick for contacts*—before the physicist finally spoke.

"Oh, yes, you must be Dr. Hoffman." His voice was high, nasal, monotonically formal. "Please sit down." He picked up a pile of books and papers from a chair, and put them on an already impossibly cluttered workbench. "I'm intrigued by your letters; I'd be very interested in hearing the exact manner in which you'd like to use the neutrino phaser."

Hoffman had no clues about how to act, but sensed he had to sell both his idea and himself at the same time. He decided on the side of humanity, smiling warmly into his reply: "I sure hope so, Dr. Meneely, because that's why I'm here. We'd like to build a rather unique kind of computer . . .

". . . So we need a completely benign method of internally scanning a live human to build the electric analog. Oh. And one last thing, if you're interested. I've been authorized to offer you a salary of one megabuck if we can use your instrument and services."

Hoffman had talked for fifteen minutes without a sign of life from Meneely. Now the physicist spoke:

"Dr. Hoffman, since I demonstrated the phaser for the first time several months ago, I've had a multitude of requirements, requests, and demands presented me for its immediate employment. None of them interested me more than my current study, so I ignored them as best I could. But what you want to do is both interesting and worthwhile. I'm inclined very much to . . . say, do you play billiards?"

Hoffman, startled, focused his eyes on the physicist's face. Miraculously, it was engaged in an embarrassed grin. In a flash of insight, the physiologist realized that Meneely was one of those rare people who lacked the ability to shade his relationships with others; he was either completely formal or completely friendly, depending on some mysterious decision circuit in his head. He thought fleetingly that the physicist must have been hurt enough times so that he was usually slow to

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offer friendship. Considering himself lucky, he smiled.

"Matter of fact, I used to play quite a bit. Out of practice, though."

Meneely somehow looked relieved and eager at the same time. "Come on. I know a place that has tables with real slate beds instead of plastic hardpack. We can talk between innings." He shrugged off his lab coat, seeming to doff about twenty years in the process. Hoffman happily walked out the held-open door.

". . . Cause of overlapping surface effects, the single lattice-layers of the new styrometals emit monoenergetic, unidirectional betas along one axis, and likewise neutrinos along another, if you hit them with a uniform magfield and laser pulse at the same time." Meneely was speaking as he lined up the break shot. "What I found out was that you could turn around and make an inferential detector out of the same kind of setup." He pushed his cue ball smoothly with top right english; both men watched as it began its long journey to the red ball, into the left corner, back against the right rail and squarely into Hoffman's ball with a soft click. He was already in position for the next shot. "The only trick was to set up the computer to analyze the magfield changes in speed-of-light space, then make the coordinate transformations back to four-space quantum mechanics to deduce exactly where the neutrinos are when they pass through the target."

"Good stroke," Hoffman murmured half to himself, then, louder, "Speed-of-light space? What the Devil is that?"

"Huh? Why, I guess you'd call it a convenient mathematics. Some of the theoretical geniuses at Cal Tech dreamed it up about ten years ago to work meaningfully with the so-called massless particles. Gives 'em analogous wavelengths, Pauli numbers, Heisenberg uncertainty, and so forth. Say, I thought physiologists had to have a good background in physics." He missed his fourth billiard by millimeters. "Your shot."

Hoffman wry-grinned. "I thought I *did* have a good background; but frankly, I couldn't work my way past the 'what-it's-going-to-do-for-science' section of the SA article." He cautiously smoothed a corner-to-corner four-railer, making the billiard with a glancing kiss.

Meneely politely banged the butt of his cue against the floor. "Nice stroke. O.K., forgetting about theory, the instrument consists basically of this neutrino emitter and a couple of detectors. A neutrino pulse goes through the first detector, target, and second detector; and the outputs of the two detectors are compared, using that special SOL mathematics I was talking about. Then by quantum-mechanical 'back-dating,' so to speak, you can deduce the euclidian coordinates of objects the neutrinos went 'near.' " Meneely began to look

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uncomfortable. "I'm afraid words are becoming inadequate. If only you knew a few simple quantum tensor transformations, or—"

"Please." Hoffman held up a hand. "My ignorance is quite blissful; play like I understand. Besides, it's your shot."

Meneely had been polishing his glasses; now he put them back on and got up to examine the position of the balls on the table. Hoffman continued:

"Now, what kind of an output do you get from this thing?"

"Well, in the first place, it takes three of the detector-emitter setups on orthogonal axes to get a meaningful output—you can probably see the logic behind that. The raw data from each shot are in the form of 10^9 orthogonal coordinate sets; each set represents a billionth of the volume scanned, and is assigned a 'strength,' if you will, by the computer. The strength determines how solid, or transparent, that tiny volume element will appear in the output hologram."

Hoffman frowned. "That makes me worry about your resolving power. I'm afraid anything much smaller than individual cells would clutter up the picture beyond recognition."

The physicist smiled. "The usual query is the other way around. Some classical ignoramuses still refuse to believe that I can get the resolution I claim without using a 'baseball microscope.' He paused to execute a difficult stroke with heavy reverse english; his ball struck Hoffman's, backed up around the near end, and died just as it kissed the red. Hoffman banged his stick on the floor.

"As for your problem," Meneely continued, "don't worry about it. The phaser isn't a constant-resolution instrument. In fact, the term 'resolution' can only be used in the final output stage where some three-dimensional analog is employed. This 'resolving power' is determined by several things like neutrino energy density, alignment accuracy, uncertainties involved in the transformation statistics, and so on. In the final analysis this 'resolution' is roughly a linear function of the volume examined in one shot. Now, what kind of resolution do you want?"

The neurophysiologist thought for a moment. "Anything smaller than about a tenth of a micron will have to be pretty transparent. What size volume would that correspond to in a single shot?"

"Hm-m-m, about a cubic centimeter. Maybe slightly larger."

Hoffman felt relief flood him. "Thank God! I had horrible visions of scanning little one-millimeter cubes and taking forever to do the job." He watched as Meneely made his fifteenth point to win the game. "Nice shooting. Oh, one more thing, Clint. We plan to build our computer with WiBAViS; can you set the phaser up to scan slowly?"

Meneely frowned, thought a sec-

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ond. "It'd be easier to have it sample a section, then make a discreet jump to sample the next. And from what I know about WiBAViS, I think the hookup would be simpler that way, too. By the way, who's going to be your computer man?"

"A Dr. Jerome Kale. I don't know the first thing about him, except that he's supposed to be a big name in the field, and that he's a very good friend of Bob Macpherson, who's footing the bill for the project. I'm going to pick him up next week at some kind of business luncheon in Chicago."

". . . Can be said that the rate of growth of the computer industry has not only kept up with that of transistors and lasers, but has been approximately the *product* of the two.

"I was hardly more than a toddler when the industry began its boom back in the early 1960s; in those days, the old expression for cost was 'a buck a bit,' so if some forward-looking firm wanted a huge, cumbersome machine with a million-bit core, it had to be ready to spend a megabuck. Disc and magtape storage were cheaper but much, much slower than even those old magnet cores.

"But virtually all the computer firms were plowing a remarkable twenty percent of gross income right back into research. Within a decade the troublesome discs had been replaced by stationary ferrite drums, and fast cores were no longer magnets, but simple flip-flops in wafer cubes. By the early '70s the cost of the newer and faster machines was down by a factor of fifty; big and little companies alike fell over themselves donating their outdated systems to universities and high schools. At this same time, the first really efficient wireless transmission device was realized in the development of the light diode; this in turn brought about the boom in the home-neighborhood-city central computer systems, and the concomitant growth of the retail software industry to coddle housewives too lazy to program their own home units.

"By the beginning of the '80s we had developed micropunch tape, and had virtually unlimited on-line storage for fast retrieval. During the '80s, also, the S-band laser enabled us to create continuous all-weather computer communications around and off the globe. The industry by then had spread into virtually every aspect of human life from surgery to ecology, from research planning to menu planning, from raising toddlers to governing nations.

"During the past decade or so, the emphasis has shifted to developing more miniaturization, programming methods, and flexibility. We've seen as a result the development of WiBAViS, self-breeding cores, ten and five molecule wafers, and the patenting of the Holovistor circuit by RCA. The computer has truly become potentially infinite in its product out-

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put; its only limits are the bounds of your imagination!"

Dr. Jerome J. Kale gathered his notes together and stepped back from the podium amidst enthusiastic applause from the collected members of the American Association of Scientific Businessmen.

Hoffman, waiting for him in the wings, was still amazed by the duality of the computer scientist. He looked nearly subhuman—short, extremely broad, with low, slanting forehead and thick, dark features. His voice was raspy and his social language—in the short time during the day that Hoffman had had to judge—could be coarse at times. But the man could also be incredibly erudite, and was considered brilliant in his chosen discipline; he held PhDs in electrical engineering and computer science, was the author of a host of papers, owner of several patents, past president of CSAA, an FRS (honorary), ad infinitum. As Kale entered the wings, Hoffman greeted him.

"Pretty good speech."

"You really think so? I can't tell anymore; I give the same talk ten times a year with minor variations. Ready to go?"

"Any time, Jay."

"You're talking my language. I've been excited as a kid ever since I got that phone call from Mac a couple of months ago. Been waiting two years for a good excuse to quit that paper-pushing, butt-spreading vice presidency at General Software, and I'm happy to say that the last word of that speech was my final instant of employment." He forced his massive shoulders into a topcoat. "Meneely still planning to get on the plane in Denver?"

"No; I got a call from him about three hours ago. He had a last-minute job to take care of, so he'll catch a commercial flight to Seattle and meet us there tomorrow." The neurophysiologist glanced at his watch. "In the meantime, our bird leaves in about forty-five minutes. Let's go."

During the flight Kale snored quietly, victim of the soporific whispering of the ramjet. Hoffman sat unmoving, eyes open, dreaming in that peculiarly self-aware fashion of the complex mind. Kale awoke as the jet changed modes for the descent, and glanced out the window.

"Hey, aren't we pretty far north for the approach to Sea-Tac?"

"Huh?" Hoffman broke out of his reverie. "Oh, didn't I tell you? The airstrip at the laboratory is finished, now. We're going directly in to Whidbey Island.

"Oh." The computer scientist yawned, stretched. "How 'bout our condoms. How're they comin' along?"

"All ready. You can send for your family and furniture any time. In fact, Meneely's bringing his wife with him so she can buy new furniture in Seattle." Hoffman picked up the yawn from Kale, used it to pop

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his ears. "Some of the technicians and machinists have already moved in."

"Say, what's this guy Meneely really like? I've heard conflicting stories."

Hoffman smiled, remembering the thoroughly enjoyable week he'd spent with the Meneelys. "A really brilliant man, but a little slow, socially; he takes a while to make friends, sometimes, so go easy on him at first. But you won't have to hold back on shop talk—in fact, I think he's already got some ideas of his own about the phaser-WiBAViS interface." He buckled his seatbelt. "And he shoots a damned good stick of billiards."

As he approached the door to his office, Hoffman reflected that if the hecticity of the three days since his landing on Whidbey were any indication, he'd be a sorry person by the end of the five-year project. He opened the door to find Meneely and Kale each occupying a corner of his desk.

". . . A standard algorithm interface modified with a Dibiase splitter to sample in two dimensions."

"Yes, but you see, I'm already using Gestalt algorithms in my interpretive output circuits. Now it might be possible to shortcut directly into the breeder command circuits by—" Meneely looked up, waved casually. "Morning, Hank. Are we finally ready?"

"Hi, Clint, Jay. I hope so. You guys both got your notes warmed up? Good, let's run it." He strode around the desk, sat down, and took a sheaf of notes from the top drawer. "Have a seat, fellas. This is gonna take a while." He reached over to a panel on the side of the desk, flipped a switch, cleared his throat, and began talking in the overloud tone of the novice using a tape:

"Official report. From: Associative Computer Research Project, Whidbey Island, Washington. To: Dr. Robert Macpherson, Director of Research, Library of Congress, Washington, D.C. Subject: Organizational and first progress report of ACRP. Reporting: Dr. Henry D. Hoffman, Project Director and Chief of Physiological Division, Dr. Jerome J. Kale, Chief of Computer Division, and Dr. Clinton T. Meneely, Chief of Bioinstrumentation Division. The report of the Project Director follows . . ."

An hour later Hoffman flipped the recorder off, leaned back in his chair, and sighed gratefully. Well, that does it for six months. Now the fun begins. You've both done a fine job of luring good people out here to work on the project." He grinned devilishly. "Being able to offer long contracts at exorbitantly high wages has its advantages. Now. How long do you think it'll take you to set up that self-breeding core, Jay?"

"Well, it appears that we don't have to make any radical design changes, except to modify the WiBAViS to work in the five-molecule

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matrix. And we have a break with Clint's phaser; the interface looks like it'll be a snap. Our only real problem is to design an efficient setup to take care of the sheer number of core elements involved." He scratched his mop of black hair. "Let's see, I've got Tilsen coming out here from Bell labs in about six months, and I figure it'll be seven or eight months after that we'll be ready to go. Call it fifteen months to be safe."

Hoffman looked doubtful. "Only fifteen months. Are you sure? Nobody's ever tried to set up something this comprehensive before, have they?"

"Don't worry, Hank," Kale said confidently, "the obstacles aren't technological, only adaptive," he smiled; "and, you know, computer men have a long history of adapting creations to novel ends."

"Good," Hoffman said. "Then you'll have time to set up the WiBAViS to do the initial statistical work on the internal and peripheral receptors. Before we can even begin to design the indicator circuits we have to get distribution and density functions for every type of motor and autonomic nerve ending in every part of the body. Our big board is going to be crowded enough even with a five thousand-to-one reduction in the receptor/effector network; and to do that reduction I've *got* to have those statistics. Now, Clint, when will your brainchild be ready for scanning? I need it as soon as possible."

"For single-volume scans, I'll have it ready just as soon as I get it unpacked and aligned." He took off his glasses, and inspected them myopically. "Call it a couple of weeks. But as for trying to build a picture out of two or more volume shots, we've got to wait until we can come up with that clamp. And the final model, integrated into WiBAViS, will probably be a couple of years in the building."

Hoffman nodded, musing half out loud. "And I'll probably need at least twenty months myself to classify the unknown . . ." He stopped and thought intently for two minutes, then began again:

"O.K., the way I see it, we'll attack the problems this way . . ."

Robert Macpherson seated himself comfortably in the easy chair in Hoffman's office, and gazed briefly out the window at the brown and green definition of Whidbey Island in early winter. Hoffman was just beginning to speak.

". . . Begin to tell you how grateful we all are at being given a free hand here, Bob. When I told you to give me the money and leave me alone for a couple of years, we were both giggling drunk; I had no idea you'd take me literally."

Macpherson chuckled. "You've got some old-fashioned ideas about how research administrators operate these days, Hankboy. By the time the first Secretary of Research and Technology was sworn into the Cabinet,

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the government had learned quite a bit about the science of science, and we've continued to learn. With the Ecological Balance Program under tight control and almost licked, we get more and more money each year allotted to pure research. We're perfectly willing to give modest sums to bright lads with good ideas; and for substantial grants like yours we look at the basic concept, and the reputation and past work of the head man involved, then let him have his head. It's worked beautifully—you ought to see the size of the spin-off patent file from 1980-to-present. Why, even if the associative computer is a complete flop, the whole project will probably pay for itself in medical technology advances alone." He smiled. "But knowing you, I don't think it'll flop."

Hoffman mirrored his smile. "Hope you're right; it's been increasingly harder during the past couple of years to see the forest. But I think we'll be ready in six months or so to start putting it all together." He stood up. "Well, ready for the two-bit tour?"

"Lead on."

Hoffman stepped to the door, opened it, and motioned Macpherson out. "To the left; we'll visit the bioinstrumentation lab first." He checked his watch. "Clint Meneely should still be there; I'll let him tell you about his setup."

They walked into Meneely's laboratory; as always, it was a visual assault. Papers, scopes, and instrument racks abounded in apparently thoughtless disorder. Hoffman looked at the director's face, laughed softly. "It used to affect me that way, too, but I got over it. It's the only kind of environment Clint feels at home in. He—" Meneely's face popped up from behind a small core-talk unit. "Speak of the devil. Hi, Clint. Meet Bob Macpherson."

Meneely came around to the front of the console, wiping his hand on his lab coveralls. "How do you do, sir." They shook hands rather warmly while Hoffman looked on thankfully. He liked them both, and had done as much verbal groundwork as possible to make the physicist feel at home with Macpherson.

Meneely spoke shyly: "Welcome to the 'rat's nest,' Dr. Macpherson."

"It's a pleasure to meet you, Clint. Understand you shoot a good stick."

Meneely's eyes lit up. "Well, my game's been going downhill the past couple of years." He looked slyly at Hoffman. "No competition, you know."

Macpherson hooked his thumb at the neurophysiologist. "If he's the only guy you have to play with, I don't blame you. I tried to teach him the game in college, but he couldn't do much more than soak up the rudiments."

Hoffman, laughing, broke into the conversation. "Please, fellows, my poor ego! Besides, we've only got half an hour till luncheon—then we'll see who sniggers at whom."

"You're on," said Macpherson,

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grinning. Then, turning to the physicist, "Say, I understand you've got a tourist attraction around here, somewhere."

"You mean the phaser setup? It's right in the next room. Come on, I'll show it to you."

As Meneely opened the door for the Director, Hoffman followed, really understanding for the first time the reason for Macpherson's success in the human hustle of the nation's capital. The man honestly enjoyed people; others felt that enjoyment, and responded to it.

The appearance of the "examining room," as it was called by the staff, was a neat visual opposite of Meneely's private lab—attesting to the essential orderliness of the technicians who worked there. Its dominating feature was a high, man-sized table in the center, ringed by six pieces of apparatus that looked disturbingly like laser slicers. The left-hand wall was completely occupied by several special-purpose computers, and the right wall contained a long rack on which hung half a dozen milk-colored plastic creations. They looked like human-shaped cocoons, the front halves of which had been sliced away. On the wall directly in front of the three men were arranged a multitude of recording instruments set in racks. High up on the left, a thigh-thick cable ran through a hole from the adjoining room to disappear behind the computers on the left wall. From the ceiling were suspended several movable hooks which supported cables running in all directions.

Meneely paused quietly for a moment at the entrance, as if sensing the need of a stranger to orient himself, then spoke to Macpherson: "I assume you know how the phaser works."

"Hm-m-m? Oh, yeah. Hank here gave me a layman's version last night to cover the points I didn't get from the tapes." He continued to soak in the room.

Meneely grinned. "But he didn't prepare you for a grade B movie set, I bet. Come on over to the table." He indicated the entire layout with a sweeping gesture. "This is our second-generation apparatus; we're in the middle of final checkout right now. Poor Hank had to do eighteen months of exploratory experiments with a crude version we worked up in the first few weeks of the project. But no more." He pointed overhead to one of the neutrino sources. "You can see that these each move freely in two dimensions. Each detector pair— for instance this one and its twin under the table—move as one unit, and the three units are computer-controlled so we can scan any given volume element in a body lying on the table. The output is mathematically calculated and holographically displayed in the tank over there," he indicated a standard Holovistor set on the wall behind them, "and at the same time is coded algorithmically and sent to Jay's Wi-BAViS next door."

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"Neat," Macpherson murmured; then, "What are those suits hanging on the wall over there?"

"Those are Hoffman's creations. He calls them biological clamps; people who have to wear 'em have less polite names. I'll let Hank tell you about them."

Hoffman looked a little rueful. "I'm sorry nobody likes them, but they're an absolute necessity—due to one of those little problems that came up and threatened to turn into a nightmare until we finally worked it out. You see, it's a matter of micromovements—those automatic posturing adjustments that go on continuously within the muscular framework of the conscious body. Now Clint's phaser can handle micromovements, all right, but when the WiBAViS tries to fit two volume elements together by anatomical recognition patterns, relative movements of objects within each element can't be any greater than about five microns between one scan and the next.

"We've finally evolved two methods of movement control which we use in conjunction to bring the errors down to where the Gestalt algorithms can handle them." He walked over to the rack of half-suits. "First thing is to have a subject fitted for one of these; they're made by contract with the Hard-pack factory over in Seattle—and it's quite an epic just to see how one of these things is molded to a skin-tight fit." He walked back to the table. "Now, when a man is going to be a subject, we take his suit and fix it rigidly to the table with these retractable pins, here; then he strips and lies down in the clamp. For most of the work I've done to date with the old phaser setup—analyzing receptor and effector distributions, determining transmitter effects, timing events by slow motion holography, and so on—the clamp is enough by itself. But for piecing together a sizable portion of the anatomy, we have to call in the hypnotherapist to put the subject in a light trance. Relaxant drugs would work splendidly, but they're out of the question, of course; they all have nonnatural effects on the nervous system."

Macpherson frowned thoughtfully. "But doesn't the subject have to breathe?"

Hoffman waved his hand deprecatingly. "Oh, we take other steps, too, like having a subject stop breathing for a moment while we take a 'picture,' timing the heart cycle so we always shoot at end-diastole, and so on. Gets pretty hairy sometimes, shooting in the torso during trance, when the subject can't control his breathing pattern. Now when we get Nelson in here for the big run in about eight months, we plan to do the whole thing all at once, in about a six-hour sitting; he'll be catheterized and given a compensating IV for on-line replacement of body fluids."

"Nelson? That name rings a bell, but I can't quite place it."

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"He's our model. Age 42, IQ 140, lots of common sense, a liking for money and a willingness to serve. And he's got total recall."

The trio moved into the adjoining laboratory. Three of the walls were taken up by large computers and computer components; the fourth, which they were facing as they walked in, was almost completely covered by thousands of tiny knobs and galvanometers. It was sectioned by white lines, and large irregular areas of the plastic facing were painted different colors; in addition, all the knobs were color-pattern coded. Each of the tiny readout meters was labeled in fine print contrasting with the background color.

Hoffman glanced at the library director, who was frankly gaping.

"Kinda gets you, doesn't it?"

Macpherson let out his breath. "That's probably the understatement of the year." He walked mechanically toward the wall, drawn by the hypnotic force of the swirling color patterns. "This, I take it, is the Big Board?"

"None other." Hoffman allowed himself to beam a little. "An electronic analog of the entire human body—or it will be after the final wiring—as complete as we can make it after eighteen months of study with the world's greatest physiological investigator." He made a mock bow towards Meneely, who returned it in good humor. "The only things we haven't finished yet are the analogs for the three special input-output devices of the head—ears, eyes, and vocal apparatus."

Macpherson looked bewildered. "How in the world do you keep track of it all? How can you tell if some part is malfunctioning?"

"See the row of lights on top? There's one light for each column of meters on the board. Now, the meters indicate nervous activity; when the activity of any of the meters in a column rises or falls to malfunction levels, the warning light over that column will come on.

"As for interpreting the board, it's not too complicated once you get used to it. It's laid out with respect to functional anatomy. The fifty-three sections outlined in broad white lines are logical anatomic divisions of the body, and each division is sectioned with fine white lines, with everything labeled. Here, for instance, is the heart analog, subdivided into atria, ventricles, and coronary blood vessels. Now the background colors represent major physiological control systems, which overlap not only the white lines, but each other." He pointed to an area painted in small green and blue checks.

Macpherson, still looking bewildered, asked: "Exactly what do the knobs and meters represent?"

"The meters are readouts of the electric analogs of nerve effector activity—the final outputs of the body control systems. The knobs allow us to create an electronic analog of internal and external environment by

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adjusting the input firing rates of the sensors. You can see that the meters are labeled; the knobs are distinguishable by what anatomic section they're located in, and their color pattern. We have patterns for each of the thirty-eight functionally different types of receptors we've classified in our studies.

"Frankly, we plan never to touch most of the knobs after we set them at initial tonic levels; you see, they can also be controlled internally by feedback circuitry, all except for the peripheral receptors. That way, when the brain core sends out a 'command,' it'll be 'fooled' into thinking that the 'body' has obeyed."

Macpherson continued to study the board for several minutes. Finally he shook his head. "*Whew!* I give up. It's just too much." He turned to Hoffman. "Now, you were speaking of the brain core—?"

Hoffman grinned. "I can take a hint; if you will direct your attention to the left wall, sir. Since Jay's in Chicago with his two top men, I'll let Clint explain the big computers. He can give you a much better snow job than I could, since you're an old computer man yourself."

The director waved a hand. "I don't think you'll need to do too much explaining, Clint. Jay's been to see me twice in D.C. and I've read both the papers he and his assistants have published in ACSJ since they began here." He scrutinized the machinery against the left wall. "However, I must admit I'm surprised at the size of the core and WiBAViS unit, since they're both using five-molecule core and talk circuits." He walked over to the brain core, fondled it.

"You can blame Hoffman for part of that," said the physicist, "since he required us to build a multispeed analog. The brain core is about three times the size of what it would have been for single-mode operation. And as for the WiBAViS, it'll get even bigger before we're done. We found out early that the only way to do the thing practically would be to first store and correlate the entire anatomic contents of the body, then wire according to program." Meneely took off his glasses, absently rubbed them against his dirty coveralls. "Unfortunately, we also had to find a way around the sheer numerical monstrosity of the operation. Nelson is a big man—masses about a hundred kilos—so we'll require about 100,000 shots with the phaser; multiply that by 10^9 coordinate points per shot, each requiring three spatial references, each reference requiring ten bits, and so on—you know the routine—and we would have had a mess trying to use normal core notation."

Macpherson nodded. "So I gathered from talking with Jerome."

"Of course, the solution was to store the algorithms themselves, spatially coding with a one-for-one correspondence with body volume coordinates, then slice and wire at leisure." Meneely put his dirtied

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glasses back on, looked surprised for a moment, took them off again and began repolishing them with a handkerchief. "Even so, it took a memory of 10^{11} bits; you can see it's about twice the size of a standard unit. Its functional twin is in the next room, spread out thin and plastered up against the backside of the Big Board, ready to breed and wire it into the brain core. We're using laser hookups for intercommunications, of course; nothing else is feasible." He inspected his glasses. "What else? Oh, yes. The saga of the poor programmers; I couldn't begin to do it justice. Hank and his boys," he pointed accusingly, "have hit them with more than seven hundred different recognition sequences, each one requiring a different wiring delay, synapse interaction coding formula, and God knows what else. And then he has the gall to demand an error figure of 10^{-6}!" He put his glasses on again, and looked at his watch. "And now, as I recall, there was a matter of lunch and billiards."

Macpherson stopped by Hoffman's lab a few minutes before his departure for Washington, D.C.

"Hi, Hankboy. Just wanted to say good-bye."

Hoffman rose from the microhologram he'd been studying. "Hi, Mac. I still wish you'd let me see you to the airstrip."

"Nothin' doing. When you told me you were humping to meet a deadline for the Federation meetings, I felt guilty about coming here in the first place; you should have told me two days ago. Before I go, though, tell me something confidentially: do you really need all those controls on the Big Board, or was that part of a plan to suck in some good physiological research talent? Not that I'd do any differently, you understand."

Hoffman chuckled. "I'd hate to have an investigating committee pin me down on that one, Bob, because I'm not sure, myself, any more. We could probably do without some of them, but I couldn't guarantee it. We have to program the computer so it'll 'learn' associative techniques and the psychologists contend that an environment analog is absolutely necessary for the machine to communicate effectively with humans. So I ended up by throwing in everything, to be absolutely certain that our final product will have full recall and associative abilities." His smile broadened. "So by the time I had the thing fully designed, it promised to be the greatest physiological research model ever built. Naturally there were a few people anxious to be associated with the project."

Macpherson smiled wryly. "Nice answer. You ever thought of taking up politics?"

"Not a chance. Even this job's driving me batty."

The two shook hands warmly, and Macpherson departed. The neurophysiologist sat back down at his

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table and quickly lost himself in his work . . .

Summer lay lushly on Whidbey Island, creating a serpentine emerald dropped across the headwaters of Puget Sound. But the several hundred beings in the main building of the ACRP complex had closed their minds to the beauties of the Pacific Northwest. For the moment, they had eyes only for the Holovistor monitors; their field was centered on a man named Nelson, who lay nude in trance, half in a white cocoon on the table of the examining room. The several beings privileged to view Nelson in the flesh were tense with quiet fatigue; they had been attending his body and its monitors for nearly six hours, as silently as possible so as not to disturb the trance state of the man. The only sound in the room was the monotonous muted clicking of the phaser as its probing, invisible pulses shifted their attentions from section to section at the steady rate of ten times per second.

In the adjoining computer room silence was not necessary, but the tension remained. Dr. Jerome Kale sat at the WiBAViS console, attended by colleagues and technicians, watching the phaser's progress in coded digital readouts. Hoffman entered from the examining room, closing the door silently behind him. "How's it going, Jay?"

"Smooth enough," the computer scientist grunted, "but I see we're almost to the ears, now. Won't be too long until slowdown."

Hoffman nodded. "That's why I came in here; I'm considered 'nonessential personnel' for the time being." He took out a handkerchief, mopped his forehead. "I thought we'd never make it through the torso; four and a half hours of off-and-on shooting is enough to drive anybody up the wall. Boy, when this is over—"

"Here we go," interrupted Kale.

Hoffman looked up at the digital readout of the current total of volume elements stored in WiBAViS. The far-right position had stopped its frantic changing and was now jerking sedately once every second. In the examining room, he knew, the remaining people were constrained to absolute silence; and the phaser had slowed to allow its own sound to be damped out before taking each scan.

After about thirty seconds a red light flashed on the panel in front of Kale, indicating a movement too large for anatomic correlation with the adjoining sections. He swore softly, then stopped abruptly as the light went out again; WiBAViS had ordered a re-scanning of the troublesome volume element, and found the second image acceptable. The phaser in the next room continued its steady journey to the top of Nelson's head.

Kale laughed softly, without humor, and said to Hoffman; "I don't know why I get so nervous every time we have to retake; it happened

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one hundred sixty-seven times in the heart-lung area. But it still makes me jumpy; deep down, I probably lack faith in all the last-minute jury rigs we've made in the past month."

Hoffman was sympathetic. "I'll probably feel the same way when it comes time to turn on the Big Board for the first time."

During the next five minutes, there were two more red flashes, but each time they persisted only a second. Finally the digital indicator began its lightning pace again. Kale sighed, then spoke loudly to the whole room: "Two minutes!"

During the final minute Hoffman stood immobile, his hand on Kale's shoulder, hypnotized by the decimal dance of the volume readout. The far right position was an almost continuous blur as it raced through its cycle, ten numbers every second, over and over. The neurophysiologist noticed absentmindedly that his eyes seemed to catch different numbers, and hold them in afterimage in an unpredictable sequence. His glance moved to the next position on the left, whose one change per second seemed a snail's pace. He had just moved his eyes to the third column when the readout suddenly stopped changing. He took in the whole display. It announced 1 1 4 8 5 7. Abruptly Hoffman realized that that was a figure he recognized from many reports and conference sessions. The run had ended.

Kale came to life, called out crisply: "Micropunch?"

"Taped, sir," answered a technician; "15.47636 kilometers. No parity error."

"Core memory?"

"Locked in, Doc. Emergency back-up power on line. We won't lose this one!"

The computer scientist turned to Hoffman, his neanderthal features spread in a wide grin. "Your model's in the books, Hank. Go give 'em the good word."

Hoffman strode into the adjoining room, smiling and holding up his thumb. Facing the front pickup of the closed-circuit holovision, he announced in a serious voice: "Ladies and gentlemen. You've worked mightily, with hardly a break, for nearly three years. Today, in this past six hours, we've seen an important culmination of that labor. For those of you who will be leaving us now, I can't begin to thank you for your devotion to the task. For those who will be staying on for the eighteen months of wiring and final six months of programming, I thank you also for your untiring efforts, and hereby proclaim a month of leave for everyone!"

As cheers went up from every part of the building, Hoffman walked

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over to a grinning Clint Meneely, and warmly took his hand. Kale joined them, and the three walked slowly out of the examining room.

POSTLOG: PROLOG

Whidbey Island was shrouded in its habitual midwinter cloud-cover. But inside the main building of the ACRP complex, warm walls and glowing ceilings pushed out the gray drizzle. In the computer room Hoffman, Meneely, Kale and Macpherson stood facing the Big Board. The room was crowded with technicians and scientists making last-minute triple-checks of level settings and status indicators. Hoffman was talking to Macpherson.

". . . Three modes of operation are designed simply as slow, intermediate, and fast. The slow mode is what we call 'biological speed.' We'll use it for a lot of the initial oral programming, and to get the feel of correct operational sequencing before we switch over to intermediate in a month or so. When we finally deliver the computer to you in Washington, the entire software for initial programming will be on fast mode tapes, so the operation can be done at 1,000 times biological speed."

Macpherson stepped over to the brain-core. "And you say this is the principal input/output?" He indicated a small speaker set into the

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console of a small auxiliary computer. Also on the console were a pair of sonic receivers, and still another pair of wide-angle photoreceptors mounted on gimbaled controls.

"Essentially, yes," Kale answered the question, "but, of course, the external I/O systems you see there will be used only in slow mode. For intermediate and fast speeds, the input system is wired in parallel directly to electronic talk-circuits. But the oral output in all modes is the movement of air molecules initiated by the vocal cord analog; we'll tape directly, of course. For written output, Hank suggested we wire seventy of the skeletal muscle effectors into the key-activators of a speedwriter; it's on the right side of the Big Board, over there. Matter of fact, we just finished the programming for that output mode."

While they had been talking, the technicians had one by one finished their inspections and stepped back from the Big Board and brain core. Kale looked around, glanced at his watch, and sang out to the room:

"Status report! Parity?"

"Parity O.K., Jay."

"Initial input levels?"

"All nominal at tonic values."

"Speedwriter?"

"Switched in, Doc."

"Special senses I/O?"

"In circuit, sir. Slow mode."

"Core status?"

"Core running on full standby, Jay. Slow mode. Consumption 130 watts."

"Laser intercoms?" Kale asked.

"All hot, sir."

"Oral programmer?" Kale turned to a man on his left. "Go ahead and take your place, Sam." The man to whom he had spoken detached himself from the group in the center, and went over to stand by the sonic receptors. He cleared his throat self-consciously.

The computer scientist turned to Hoffman, said with formality: "I believe the honor should be yours, sir."

Hoffman nodded, stepped to the main console, and placed his hand over a switch labeled CORE/PERIPHERY INTERCONNECT. He flipped it perfunctorily and stepped back from the console, noting that the power consumption indicator had swung abruptly to three hundred watts. He turned to the right, eyes sweeping the Big Board; almost every one of the thousands of readouts was displaying motion of some kind. He nodded to Kale.

Kale said: "O.K., Sam, start the initial in—"

He was suddenly interrupted by a sporadic clattering from the right side of the Big Board; the speedwriter had suddenly come to life. Kale held up a hand, a startled look on his face. "Wait a minute, Sam." He walked over to the instrument. It was printing out random symbols. "What the hell—"

Again he was interrupted, this time by the oral output speaker. It had burst into a wailing ululation,

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filling the room with its weird sound.

Hoffman, who had just looked back to the Big Board from the speedwriter, suddenly froze, vision blurring as realization struck him. In a daze he walked over to the division on the board marked "Stomach," searched briefly, found a section labeled "fundus." He reached up and slowly turned one of the knobs until the speaker stopped its screeching. Turning to Kale, who was looking at him questioningly, he smiled idiotically, and said: "Hungry."

As if in confirmation, the unmistakable sound of a belch burst from the output speaker, followed almost immediately by a contented gurgling noise.

As comprehension swept the computer room, the scientists and technicians fell silent, listening in fascination to the speaker's unintelligent but utterly meaningful output. Hoffman stood completely lost in thought as the gurgling slowly subsided; the speedwriter stopped its rapid clicking, leveled off to an occasional burst.

Finally the neurophysiologist seemed to make a silent decision within himself. He sighed, straightened out his slumped shoulders. Life returned to his eyes and voice. He spoke to Macpherson. "Bob, our delivery schedule is going to be somewhat delayed—maybe by years. Maybe even forever." Then, turning to Kale, "Jay, I'm calling a meeting in my office in half an hour. Bring your section chiefs and all your programmers; I want to see the staff psychologist, too. Oh, and have somebody make an announcement that I'd like the attendance of all personnel who have children less than five years old.

He stopped and cocked an ear toward the speaker. It was now emitting a soft, rhythmic rasping noise. Hoffman smiled, walked over to the console, and turned a knob marked "Oral Input Intensity Level" all the way counterclockwise. Turning back around, he explained: "Wouldn't want to wake him."

He spoke once again to the computer scientist. "Before you come, Jay, slap a permanent cover over the core/periphery interconnect—the spinal shock would be serious if someone accidentally turned it off. And put two emergency power backups into the core circuit; we have some serious thinking to do about the legal and moral implications of a power failure.

He strode toward the door, gathering up the still-dazed Macpherson. As they walked out together, Hoffman was talking: ". . . Know you have a pretty good latch on the Secretary. Now the grant we'll need won't have to be large, but must be guaranteed for several years; I figure eventually, though, we'll be getting plenty of contributions from interested . . ."

The door shut on the two men.

The computer continued to snore contentedly. ■

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A Little Knowledge

It's amazing
how much misunderstanding
can stem from the way
a man uses a language.
It tends to give one
false impressions
of his character. . . . .

POUL ANDERSON
ILLUSTRATED BY MICHAEL GILBERT

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They found the planet during the first Grand Survey. An expedition to it was organized very soon after the report appeared; for this looked like an impossibility.

It orbited its G9 sun at an average distance of some three astronomical units, thus receiving about one eighteenth the radiation Earth gets. Under such a condition—and others, e.g., the magnetic field strength which was present—a subjovian ought to have formed; and indeed it had fifteen times the terrestrial mass. But—that mass was concentrated in a solid globe. The atmosphere was only half again as dense as on man's home, and breathable by him.

"Where 'ave h'all the H'atoms gone?" became the standing joke of the research team. Big worlds are supposed to keep enough of their primordial hydrogen and helium to completely dominate the chemistry. Paradox, as it was unofficially christened, did retain some of the latter gas, to a total of eight percent of its air. This posed certain technical problems which had to be solved before anyone dared land. However, land the men must; the puzzle they confronted was so delightfully baffling.

A nearly circular ocean basin suggested an answer which studies of its bottom seemed to confirm. Paradox had begun existence as a fairly standard specimen, complete with four moons. But the largest of these, probably a captured asteroid, had had an eccentric orbit. At last perturbation brought it into the upper atmosphere, which at that time extended beyond Roche's limit. Shock waves, repeated each time one of those ever-deeper grazings was made, blew vast quantities of gas off into space: especially the lighter molecules. Breakup of the moon hastened this process and made it more violent, by presenting more solid surface. Thus at the final crash, most of those meteoroids fell as one body, to form that gigantic astrobleme. Perhaps metallic atoms, thermally ripped free of their ores and splashed as an incandescent fog across half the planet, locked onto the bulk of what hydrogen was left, if any was.

Be that as it may, Paradox now had only a mixture of what had hitherto been comparatively insignificant impurities, carbon dioxide, water vapor, methane, ammonia, and other materials. In short, except for a small amount of helium, it had become rather like the young Earth. It got less heat and light, but greenhouse effect kept most of its water liquid. Life evolved, went into the photosynthesis business, and turned the air into the oxynitrogen common on terrestrials.

The helium had certain interesting biological effects. These were not studied in detail. After all, with the hyperdrive opening endless wonders to them, spacefarers tended to choose the most obviously glam-

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orous. Paradox lay a hundred parsecs from Sol. Thousands upon thousands of worlds were more easily reached; many were more pleasant and less dangerous to walk on. The expedition departed and had no successors.

First it called briefly at a neighboring star, on one of whose planets were intelligent beings that had developed a promising set of civilizations. But, again, quite a few such lay closer to home.

The era of scientific expansion was followed by the era of commercial aggrandizement. Merchant adventurers began to appear in the sector. They ignored Paradox, which had nothing to make a profit on, but investigated the inhabited globe in the nearby system. In the language dominant there at the time, it was called something like Trillia, which thus became its name in League Latin. The speakers of that language were undergoing their equivalent of the First Industrial Evolution, and eager to leap into the modern age.

Unfortunately, they had little to offer that was in demand elsewhere. And even in the spacious terms of the Polesotechnic League, they lived at the far end of a long haul. Their charming arts and crafts made Trillia marginally worth a visit, on those rare occasions when a trader was on such a route that the detour wasn't great. Besides, it was as well to keep an eye on the natives. Lacking the means to buy the important gadgets of Technic society, they had set about developing these for themselves.

Bryce Harker pushed through flowering vines which covered an otherwise doorless entrance. They rustled back into place behind him, smelling like allspice, trapping gold-yellow sunlight in their leaves. That light also slanted through ogive windows in a curving wall, to glow off the grain of the wooden floor. Furniture was sparse: a few stools, a low table bearing an intricately faceted piece of rock crystal. By Trillian standards the ceiling was high; but Harker, who was of average human size, must stoop.

Witweet bounced from an inner room, laid down the book of poems he had been reading, and piped, "Why, be welcome, dear boy—Oo-oo-ooh!"

He looked down the muzzle of a blaster.

The man showed teeth. "Stay right where you are," he commanded. The vocalizer on his breast rendered the sounds he made into soprano cadenzas and arpeggios, the speech of Lenidel. It could do nothing about his vocabulary and grammar. His knowledge did include the fact that, by omitting all honorifics and circumlocutions without apology, he was uttering a deadly insult.

That was the effect he wanted—deadliness.

"My, my, my dear good friend from the revered Solar Commonwealth," Witweet stammered,

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"is this a, a jest too subtle for a mere pilot like myself to comprehend? I will gladly laugh if you wish, and then we shall enjoy tea and cakes. I have genuine Lapsang Soochong tea from Earth, and have just found the most darling recipe for sweet cakes—"

"Quiet!" Harker rapped. His glance flickered to the windows. Outside, flower colors exploded beneath reddish tree trunks; small bright wings went fluttering past; The Waterfall That Rings Like Glass Bells could be heard in the distance. Annanna was akin to most cities of Lenidel, the principal nation on Trillia, in being spread through an immensity of forest and parkscape. Nevertheless, Annanna had a couple of million population, who kept busy. Three aircraft were crossing heaven. At any moment, a pedestrian or cyclist might come along The Pathway Of The Beautiful Blossoms And The Bridge That Arches Like A Note Of Music, and wonder why two humans stood tense outside number 1337.

Witweet regarded the man's skinsuit and boots, the pack on his shoulders, the tightly-drawn sharp features behind the weapon. Tears blurred the blue of Witweet's great eyes. "I fear you are engaged in some desperate undertaking which distorts the natural goodness that, I feel certain, still inheres," he quavered. "May I beg the honor of being graciously let help you relieve whatever your distress may be?"

Harker squinted back at the Trillian. *How much do we really know about his breed, anyway? Damned nonhuman thing—Though I never resented his existence till now*—His pulse knocked; his skin was wet and stank, his mouth was dry and cottony-tasting.

Yet his prisoner looked altogether helpless. Witweet was an erect biped; but his tubby frame reached to barely a meter, from the padded feet to the big, scalloped ears. The two arms were broomstick thin, the four fingers on either hand suggested straws. The head was practically spherical, bearing a pug muzzle, moist black nose, tiny mouth, quivering whiskers, upward-slanting tufty brows. That, the tail, and the fluffy silver-gray fur which covered the whole skin, had made Olafsson remark that the only danger to be expected from this race was that eventually their cuteness would become unendurable.

Witweet had nothing upon him except an ornately embroidered kimono and a sash tied in a pink bow. He surely owned no weapons, and probably wouldn't know what to do with any. The Trillians were omnivores, but did not seem to have gone through a hunting stage in their evolution. They had never fought wars, and personal violence was limited to an infrequent scuffle.

Still, Harker thought, *they've shown the guts to push into deep space. I daresay even an unarmed policeman—Courtesy Monitor—could*

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use his vehicle against us, like by ramming.

Hurry!

"Listen," he said. "Listen carefully. You've heard that most intelligent species have members who don't mind using brute force, outright killing, for other ends than self-defense. Haven't you?"

Witweet waved his tail in assent. "Truly I am baffled by that statement, concerning as it does races whose achievements are of incomparable magnificence. However, not only my poor mind, but those of our most eminent thinkers have been engaged in fruitless endeavors to—"

"Dog your hatch!" The vocalizer made meaningless noises and Harker realized he had shouted in Anglic. He went back to Lenidellian-equivalent. "I don't propose to waste time. My partners and I did not come here to trade as we announced. We came to get a Trillian spaceship. The project is important enough that we'll kill if we must. Make trouble, and I'll blast you to greasy ash. It won't bother me. And you aren't the only possible pilot we can work through, so don't imagine you can block us by sacrificing yourself. I admit you are our best prospect. Obey, cooperate fully, and you'll live. We'll have no reason to destroy you." He paused. "We may even send you home with a good piece of money. We'll be able to afford that."

The bottling of his fur might have made Witweet impressive to another Trillian. To Harker, he became a ball of fuzz in a kimono, an agitated tail and a sound of coloratura anguish. "But this is insanity . . . if I may say that to a respected guest . . . One of *our* awkward, lumbering, fragile, unreliable prototype ships—when you came in a vessel representing centuries of advancement—? Why, why, why, in the name of multiple sacredness, why?"

"I'll tell you later," the man said. "You're due for a routine supply trip to, uh, Gwinsai Base, starting tomorrow, right? You'll board this afternoon, to make final inspection and settle in. We're coming along. You'll be leaving in about an hour's time. Your things must already be packed. I didn't cultivate your friendship for nothing, you see! Now, walk slowly ahead of me, bring your luggage back here and open it so I can make sure what you've got. Then we're on our way."

Witweet stared into the blaster. A shudder went through him. His fur collapsed. Tail dragging, he turned toward the inner rooms.

Stocky Leo Dolgorov and ash-blond Einar Olafsson gusted simultaneous oaths of relief when their leader and his prisoner came out onto the path. "What took you that time?" the first demanded. "Were you having a nap?"

"Nah, he entered one of their bowing, scraping, and unction-smearing contests." Olafsson's grin held scant mirth.

"Trouble?" Harker asked.

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"N-no . . . three, four passers-by stopped to talk—we told them the story and they went on," Dolgorov said. Harker nodded. He'd put a good deal of thought into that excuse for his guards' standing around—that they were about to pay a social call on Witweet but were waiting until the pilot's special friend Harker had made him a gift. A lie must be plausible, and the Trillian mind was not human.

"We sure hung on the hook, though." Olafsson started as a bicyclist came around a bend in the path and fluted a string of greetings.

Dwarfed beneath the men, Witweet made reply. No gun was pointed at him now, but one rested in each of the holsters near his brain. (Harker and companions had striven to convince everybody that the bearing of arms was a peaceful but highly symbolic custom in *their* part of Technic society, that without their weapons they would feel more indecent than a shaven Trillian.) As far as Harker's wire-taut attention registered, Witweet's answer was routine. But probably some forlornness crept into the overtones, for the neighbor stopped.

"Do you feel quite radiantly well, dear boy?" he asked.

"Indeed I do, honored Pwiddy, and thank you in my prettiest thoughts for your ever-sweet consideration," the pilot replied. "I . . . well, these good visitors from the starfaring culture of splendor have been describing some of their experiences—oh, I simply must relate them to you later, dear boy!—and naturally, since I am about to embark on another trip, I have been made pensive by this." Hands, tail, whiskers gesticulated. *Meaning what?* wondered Harker in a chill; and clamping jaws together: *Well, you knew you'd have to take risks to win a kingdom.* "Forgive me, I pray you of your overflowing generosity, that I rush off after such curt words. But I have promises to keep, and considerable distances to go before I sleep."

"Understood." Pwiddy spent a mere five minutes bidding farewell all around before he pedaled off. Meanwhile several others passed by. However, since no well-mannered person would interrupt a conversation even to make salute, they created no problem.

"Let's go." It grated in Dolgorov's throat.

Behind the little witch-hatted house was a pergola wherein rested Witweet's personal flitter. It was large and flashy—large enough for three humans to squeeze into the back—which fact had become an element in Harker's plan. The car that the men had used during their stay on Trillia, they abandoned. It was unmistakably an off-planet vehicle.

"Get started!" Dolgorov cuffed at Witweet.

Olafsson caught his arm and snapped: "Control your emotions! Want to tear his head off?"

Hunched over the dashboard, Wit-

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weet squeezed his eyes shut and shivered till Harker prodded him. "Pull out of that funk," the man said.

"I . . . I beg your pardon. The brutality so appalled me—" Witweet flinched from their laughter. His fingers gripped levers and twisted knobs. Here was no steering by gestures in a lightfield, let alone simply speaking an order to an autopilot. The overloaded flitter crawled skyward. Harker detected a flutter in its grav unit, but decided nothing was likely to fail before they reached the spaceport. And after that, nothing would matter except getting off this planet.

Not that it was a bad place, he reflected. Almost Earthlike in size, gravity, air, deliciously edible life forms—an Earth that no longer was and perhaps never had been, wide horizons and big skies, caressed by light and rain. Looking out, he saw woodlands in a thousand hues of green, meadows, river-gleam, an occasional dollhouse dwelling, grainfields ripening tawny and the soft gaudiness of a flower ranch. Ahead lifted The Mountain Which Presides Over Moonrise In Lenidel, a snowpeak pure as Fuji's. The sun, yellower than Sol, turned it and a few clouds into gold.

A gentle world for a gentle people. Too gentle.

Too bad. For them.

Besides, after six months of it, three city-bred men were about ready to climb screaming out of their skulls. Harker drew forth a cigarette, inhaled it into lighting and filled his lungs with harshness. *I'd almost welcome a fight,* he thought savagely.

But none happened. Half a year of hard, patient study paid richly off. It helped that the Trillians were—well, you couldn't say lax about security, because the need for it had never occurred to them. Witweet radioed to the portmaster as he approached, was informed that everything looked O.K., and took his flitter straight through an open cargo lock into a hold of the ship he was to pilot.

The port was like nothing in Technic civilization, unless on the remotest, least visited of outposts. After all, the Trillians had gone in a bare fifty years from propeller-driven aircraft to interstellar spaceships. Such concentration on research and development had necessarily been at the expense of production and exploitation. What few vessels they had were still mostly experimental. The scientific bases they had established on planets of next-door stars needed no more than three or four freighters for their maintenance.

Thus a couple of buildings and a ground-control tower bounded a stretch of ferrocrete on a high, chilly plateau; and that was Trillia's spaceport. Two ships were in. One was being serviced, half its hull plates removed and furry shapes swarming over the emptiness within. The other, assigned to Witweet, stood on

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landing jacks at the far end of the field. Shaped like a fat torpedo, decorated in floral designs of pink and baby blue, it was as big as a Dromond-class hauler. Yet its payload was under a thousand tons. The primitive systems for drive, control, and life support took up that much room.

"I wish you a just too, too delightful voyage," said the portmaster's voice from the radio. "Would you honor me by accepting an invitation to dinner? My wife has, if I may boast, discovered remarkable culinary attributes of certain sea weeds brought back from Gwinsai; and for my part, dear boy, I would be so interested to hear your opinion of a new verse form with which I am currently experimenting."

"No . . . I thank you, no, impossible, I beg indulgence—" It was hard to tell whether the unevenness of Witweet's response came from terror or from the tobacco smoke that had kept him coughing. He almost flung his vehicle into the spaceship.

Clearance granted, *The Serenity of the Estimable Philosopher Ittypu* lifted into a dawn sky. When Trillia was a dwindling cloud-marbled sapphire among the stars, Harker let out a breath. "We can relax now."

"Where?" Olafsson grumbled. The single cabin barely allowed three humans to crowd together. They'd have to take turns sleeping in the hall that ran aft to the engine room. And their voyage was going to be long. Top pseudovelocity under the snail-powered hyperdrive of this craft would be less than one light-year per day.

"Oh, we can admire the darling murals," Dolgorov fleered. He kicked an intricately painted bulkhead.

Witweet, crouched miserable at the control board, flinched. "I beg you, dear, kind sir, do not scuff the artwork," he said.

"Why should you care?" Dolgorov asked. "You won't be keeping this junk heap."

Witweet wrung his hands. "Defacement is still very wicked. Perhaps the consignee will appreciate my patterns? I spent *such* a time on them, trying to get every teensiest detail correct."

"Is that why your freighters have a single person aboard?" Olafsson laughed. "Always seemed reckless to me, not taking a backup pilot at least. But I suppose two Trillians would get into so fierce an argument about the interior décor that they'd each stalk off in an absolute snit."

"Why, no," said Witweet, a trifle calmer. "We keep personnel down to one because more are not really needed. Piloting between stars is automatic, and the crewbeing is trained in servicing functions. Should he suffer harm en route, the ship will put itself into orbit around the destination planet and can be boarded by others. An extra would thus uselessly occupy space which is often needed for passengers. I am surprised that you, sir, who have set

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a powerful intellect to prolonged consideration of our astronautical practices, should not have been aware—"

"I was, I was!" Olafsson threw up his hands as far as the overhead permitted. "Ask a rhetorical question and get an oratorical answer."

"May I, in turn, humbly request enlightenment as to your reason for . . . sequestering . . . a spacecraft ludicrously inadequate by every standard of your oh, so sophisticated society?"

"You may." Harker's spirits bubbled from relief of tension. They'd pulled it off. They really had. He sat down—the deck was padded and perfumed—and started a cigarette. Through his bones beat the throb of the gravity drive: energy wasted by a clumsy system. The weight it made underfoot fluctuated slightly in a rhythm that felt wavelike.

"I suppose we may as well call ourselves criminals," he said; the Lenidellian word he must use had milder connotations. "There are people back home who wouldn't leave us alive if they knew who'd done certain things. But we never got rich off them. Now we will."

He had no need for recapitulating except the need to gloat: "You know we came to Trillia half a standard year ago, on a League ship that was paying a short visit to buy art. We had goods of our own to barter with, and announced we were going to settle down for a while and look into the possibility of establishing a permanent trading post with a regular shuttle service to some of the Technic planets. That's what the captain of the ship thought, too. He advised us against it, said it couldn't pay and we'd simply be stuck on Trillia till the next League vessel chanced by, which wouldn't likely be for more than a year. But when we insisted, and gave him passage money, he shrugged," as did Harker.

"You have told me this," Witweet said. "I thrilled to the ecstasy of what I believed was your friendship."

"Well, I did enjoy your company," Harker smiled. "You're not a bad little osco. Mainly, though, we concentrated on you because we'd learned you qualified for our uses—a regular freighter pilot, a bachelor so we needn't fuss with a family, a chatterer who could be pumped for any information we wanted. Seems we gauged well."

"We better have," Dologrov said gloomily. "Those trade goods cost us everything we could scratch together. I took a steady job for two years, and lived like a lama, to get my share."

"And now we'll be living like fakirs," said Olafsson. "But, afterward—afterward!"

"Evidently your whole aim was to acquire a Trillian ship," Witweet said. "My bemusement at this endures."

"We don't actually want the ship as such, except for demonstration purposes," Harker said. "What we want are the plans, the design. Between the vessel itself, and the ser-

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vice manuals aboard, we have that in effect."

Witweet's ears quivered. "Do you mean to publish the data for scientific interest? Surely, to beings whose ancestors went on to better models centuries ago—if, indeed, they ever burdened themselves with something this crude—surely the interest is nil. Unless . . . you think many will pay to see, in order to enjoy mirth at the spectacle of our fumbling efforts?" He spread his arms. "Why, you could have bought complete specifications most cheaply; or, indeed, had you requested of me, I would have been bubbly-happy to obtain a set and make you a gift." On a note of timid hope: "Thus you see, dear boy, drastic action is quite unnecessary. Let us return. I will state you remained aboard by mistake—"

Olafsson guffawed. Dolgorov said, "Not even your authorities can be that sloppy-thinking." Harker ground out his cigarette on the deck, which made the pilot wince, and explained at leisured length:

"We want this ship precisely because it's primitive. Your people weren't in the electronic era when the first human explorers contacted you. They, or some later visitors, brought you texts on physics. Then your bright lads had the theory of such things as gravity control and hyperdrive. But the engineering practice was something else again.

"You didn't have plans for a starship. When you finally got an opportunity to inquire, you found that the idealistic period of Technic civilization was over and you must deal with hardheaded entrepreneurs. And the price was set 'way beyond what your whole planet could hope to save in League currency. That was just the price for diagrams, not to speak of an actual vessel. I don't know if you are personally aware of the fact—it's no secret—but this is League policy. The member companies are bound by an agreement.

"They won't prevent anyone from entering space on his own. But take your case on Trillia. You had learned in a general way about, oh, transistors, for instance. But that did not set you up to manufacture them. An entire industrial complex is needed for that and for the million other necessary items. To design and build one, with the inevitable mistakes en route, would take decades at a minimum, and would involve regimenting your entire species and living in poverty because every bit of capital has to be reinvested. Well, you Trillians were too sensible to pay that price. You'd proceed more gradually. Yet at the same time, your scientists, all your more adventurous species, were burning to get out into space.

"I agree your decision about that was intelligent, too. You saw you couldn't go directly from your earliest hydrocarbon-fueled engines to a modern starship—to a completely integrated system of thermonuclear power plant, initiative-

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grade navigation and engineering computers, full-cycle life support, the whole works, using solid-state circuits, molecular-level and nuclear-level transitions, force fields instead of moving parts—an *organism* more energy than matter. No, you wouldn't be able to build that for generations, probably.

"But you could go ahead and develop huge, clumsy, but workable fission-power units. You could use vacuum tubes, glass rectifiers, kilometers of wire, to generate and regulate the necessary forces. You could store data on tape if not in single molecules, retrieve with a cathode-ray scanner if not with a quantum-field pulse, compute with miniaturized gas-filled units that react in microseconds if not with photon interplays that take a nanosecond.

"You're like islanders who had nothing better than canoes till someone stopped by in a nuclear-powered submarine. They couldn't copy that, but they might invent a reciprocating steam engine turning a screw—they might attach an airpipe so it could submerge—and it wouldn't impress the outsiders, but it would cross the ocean too, at its own pace; and it would overawe any neighboring tribes."

He stopped for breath.

"I see," Witweet murmured slowly. His tail switched back and forth. "You can sell our designs to sophonts in a proto-industrial stage of technological development. The idea comes from an excellent brain. But why could you not simply buy the plans for resale elsewhere?"

"The damned busybody League." Dolgorov spat.

"The fact is," Olafsson said, "spacecraft—of advanced type—have been sold to, ah, less advanced peoples in the past. Some of those weren't near industrialization, they were Iron Age barbarians, whose only thought was plundering and conquering. They could do that, given ships which are practically self-piloting, self-maintaining, self-everything. It's cost a good many lives and heavy material losses on border planets. But at least none of the barbarians have been able to duplicate the craft thus far. Hunt every pirate and warlord down, and that ends the problem. Or so the League hopes. It's banned any more such trades."

He cleared his throat. "I don't refer to races like the Trillians, who're obviously capable of reaching the stars by themselves and unlikely to be a menace when they do," he said. "You're free to buy anything you can pay for. The price of certain things is set astronomical mainly to keep you from beginning overnight to compete with the old-established outfits. They prefer a gradual phasing-in of newcomers, so they can adjust.

"But aggressive, warlike cultures, that'd not be interested in reaching a peaceful accommodation—they're

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something else again. There's a total prohibition on supplying their sort with anything that might help them to get off their planets in less than centuries. If League agents catch you at it, they don't fool around with rehabilitation like a regular government. They shoot you."

Harker grimaced. "I saw once on a telescreen interview," he remarked, "Old Nick van Rijn said he wouldn't shoot that kind of offenders. He'd hang them. A rope is reusable."

"And this ship *can* be copied," Witweet breathed. "A low industrial technology, lower than ours, could tool up to produce a modified design, in a comparatively short time, if guided by a few engineers from the core civilization."

"I trained as an engineer," Harker said. "Likewise Leo; and Einar spent several years on a planet where one royal family has grandiose ambitions."

"But the horror you would unleash!" wailed the Trillian. He stared into their stoniness. "You would never dare go home," he said.

"Don't want to anyway," Harker answered. "Power, wealth. yes, and everything those will buy—we'll have more than we can use up in our lifetimes, at the court of the Militants. Fun, too." He smiled. "A challenge, you know, to build a space navy from zero. I expect to enjoy my work."

"Will not the . . . the Polesotechnic League take measures?"

"That's why we must operate as we have done. They'd learn about a sale of plans, and then they wouldn't stop till they'd found and suppressed our project. But a non-Technic ship that never reported in won't interest them. Our destination is well outside their sphere of normal operations. They needn't discover any hint of what's going on—till an interstellar empire too big for them to break is there. Meanwhile, as we gain resources, we'll have been modernizing our industry and fleet."

"It's all arranged," Olafsson said. "The day we show up in the land of the Militants, bringing the ship we described to them, we'll become princes."

"Kings, later." Dolgorov added. "Behave accordingly, you xeno. We don't need you much. I'd soon as not boot you through an air lock."

Witweet spent minutes just shuddering.

The Serenity, et cetera moved on away from Trillia's golden sun. It had to reach a weaker gravitational field than a human craft would have needed, before its hyperdrive would function.

Harker spent part of that period being shown around, top to bottom and end to end. He'd toured a sister ship before, but hadn't dared ask for demonstrations as thorough as he now demanded. "I want to know this monstrosity we've got, inside out," he said while personally tearing down and rebuilding a cumbersome

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oxygen renewer. He could do this because most equipment was paired, against the expectation of eventual in-flight down time.

In a hold, among cases of supplies for the research team on Gwinsai, he was surprised to recognize a lean cylindroid, one hundred twenty centimenters long. "But here's a Solar-built courier!" he exclaimed.

Witweet made eager gestures of agreement. He'd been falling over himself to oblige his captors. "For messages in case of emergency, magnificent sir," he babbled. "A hyperdrive unit, an autopilot, a radio to call at journey's end till someone comes and retrieves the enclosed letter—"

"I know, I know. But why not build your own?"

"Well, if you will deign to reflect upon the matter, you will realize that anything we could build would be too slow and unreliable to afford very probable help. Especially since it is most unlikely that, at any given time, another spaceship would be ready to depart Trillia on the instant. Therefore, this courier is set, as you can see if you wish to examine the program, to go a considerably greater distance—though nevertheless not taking long, your human constructions being superlatively fast—to the planet called, ah, Oasis . . . an Anglic word meaning a lovely, cool, refreshing haven, am I correct?"

Harker nodded impatiently. "You are right. One of the League companies does keep a small base there."

"We have arranged that they will send aid if requested. At a price, to be sure. However, for our poor economy, as ridiculous a hulk as this is still a heavy investment, worth insuring."

"I see. I didn't know you bought such gadgets—not that there'd be a pegged price on them; they don't matter any more than spices or medical equipment. Of course, I couldn't find out every detail in advance, especially not things you people take so for granted that you didn't think to mention them." On impulse, Harker patted the round head. "You know, Witweet, I guess I do like you. I will see you're rewarded for your help."

"Passage home will suffice," the Trillian said quietly, "though I do not know how I can face my kinfolk after having been the instrument of death and ruin for millions of innocents."

"Then don't go home," Harker suggested. "We can't release you for years in any case, to blab our scheme and our coordinates. But we could, however, smuggle in whatever and whoever you wanted, same as for ourselves."

The head rose beneath his palm as the slight form straightened. "Very well," Witweet declared.

That fast? jarred through Harker. *He is nonhuman, yes, but—* The wondering was dissipated by the continuing voice:

"Actually, dear boy, I must dis-

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abuse you. We did not buy our couriers, we salvaged them."

"What? Where?"

"Have you heard of a planet named, by its human discoverers, Paradox?"

Harker searched his memory. Before leaving Earth he had consulted every record he could find about this entire stellar neighborhood. Poorly known though it was to men, there had been a huge mass of data—suns, worlds . . . "I think so. Big, isn't it? With a freaky atmosphere."

"Yes." Witweet spoke rapidly. "It gave the original impetus to Technic exploration of our vicinity. But later the men departed. In recent years, when we ourselves became able to pay visits, we found their abandoned camp. A great deal of gear had been left behind, presumably because it was designed for Paradox only and would be of no use elsewhere, hence not worth hauling back. Among these machines we came upon a few couriers. I suppose they had been overlooked. Your civilization can afford profligacy, if I may use that term in due respectfulness."

He crouched, as if expecting a blow. His eyes glittered in the gloom of the hold.

"Hm-m-m." Harker frowned. "I suppose by now you've stripped the place."

"Well, no." Witweet brushed nervously at his rising fur. "Like the men, we saw no use in, for example, tractors designed for a gravity of two-point-eight terrestrial. They can

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operate well and cheaply on Paradox, since their fuel is crude oil, of which an abundant supply exists near the campsite. But we already had electric-celled grav motors, however archaic they are by your standards. And we do not need weapons like those we found, presumably for protection against animals. We certainly have no intention of colonizing Paradox!"

"Hm-m-m." The human waved, as if to brush off the chattering voice. He slouched off, hands in pockets, pondering.

In the time that followed, he consulted the navigator's bible. His reading knowledge of Lenidellian was fair. The entry for Paradox was as laconic as it would have been in a Technic reference; despite the limited range of their operations, the Trillians had already encountered too many worlds to allow flowery descriptions. Star type and coordinates, orbital elements, mass, density, atmospheric composition, temperature ranges, and the usual rest were listed. There was no notation about habitability, but none was needed. The original explorers hadn't been poisoned or come down with disease, and Trillian metabolism was similar to theirs.

The gravity field was not too strong for this ship to make landing and, later, ascent. Weather shouldn't pose any hazards, given reasonable care in choosing one's path; that was a weakly energized environment. Besides, the vessel was meant for planetfalls, and Witweet was a skilled pilot in his fashion . . .

Harker discussed the idea with Olafsson and Dolgorov. "It won't take but a few days," he said, "and we might pick up something really good. You know I've not been too happy about the Militants' prospects of building an ample industrial base fast enough to suit us. Well, a few machines like this, simple things they can easily copy but designed by good engineers . . . could make a big difference."

"They're probably rust heaps," Dolgorov snorted. "That was long ago."

"No, durable alloys were available then." Olafsson said. "I like the notion intrinsically. I don't like the thought of our xeno taking us down. He might crash us on purpose."

"That sniveling fagot?" Dolgorov gibed. He jerked his head backward at Witweet, who sat enormous-eyed in the pilot chair listening to a language he did not understand. "By accident, maybe, seeing how scared he is!"

"It's a risk we take at journey's end." Harker reminded them. "Not a real risk. The ship has some ingenious fail-safes built in. Anyhow, I intend to stand over him the whole way down. If he does a single thing wrong, I'll kill him. The controls aren't made for me, but I can get us aloft again, and afterward we can rerig."

Olafsson nodded. "Seems worth a

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try," he said. "What can we lose except a little time and sweat?"

Paradox rolled enormous in the viewscreen, a darkling world, the sky-band along its sunrise horizon redder than Earth's, polar caps and winter snowfields gashed by the teeth of mountains, tropical forests and pampas a yellow-brown fading into raw deserts on one side and chopped off on another side by the furious surf of an ocean where three moons fought their tidal wars. The sun was distance-dwarfed, more dull in hue than Sol, nevertheless too bright to look near. Elsewhere, stars filled illimitable blackness.

It was very quiet aboard, save for the mutter of powerplant and ventilators, the breathing of men, their restless shuffling about in the cramped cabin. The air was blued and fouled by cigarette smoke; Witweet would have fled into the corridor, but they made him stay, clutching a perfume-dripping kerchief to his nose.

Harker straightened from the observation screen. Even at full magnification, the rudimentary electro-optical system gave little except blurriness. But he'd practiced on it, while orbiting a satellite, till he felt he could read those wavering traces.

"Campsite and machinery, all right," he said. "No details. Brush has covered everything. When were your people here last. Witweet?"

"Several years back," the Trillian wheezed. "Evidently vegetation grows apace. Do you agree on the safety of a landing?"

"Yes. We may snap a few branches, as well as flatten a lot of shrubs, but we'll back down slowly, the last hundred meters, and we'll keep the radar, sonar, and gravar sweeps going." Harker glanced at his men. "Next thing is to compute our descent pattern," he said. "But first I want to spell out again, point by point, exactly what each of us is to do under exactly what circumstances. I don't aim to take chances."

"Oh, no," Witweet squeaked. "I beg you, dear boy, I beg you the prettiest I can, please don't!"

After the tension of transit, landing was an anticlimax. All at once the engine fell silent. A wind whistled around the hull. Viewscreens showed low, thick-boled trees; fronded brownish leaves; tawny undergrowth; shadowy glimpses of metal objects beneath vines and amidst tall, whipping stalks. The sun stood at late afternoon in a sky almost purple.

Witweet checked the indicators while Harker studied them over his head. "Air breathable, of course," the pilot said, "which frees us of the handicap of having to wear smelly old spacesuits. We should bleed it in gradually, since the pressure is greater than ours at present and we don't want earaches, do we? Temperature—" He shivered delicately. "Be certain you are wrapped up snug before you venture outside."

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"You're venturing first," Harker informed him.

"What? Oo-ooh, my good, sweet, darling friend, no, please, no! It is *cold* out there, scarcely above freezing. And once on the ground, no gravity generator to help. why, weight will be tripled. What could I possibly, possibly do? No, let me stay inside, keep the home fires burning—I mean keep the thermostat at a cozy temperature—and, yes, I will make you the nicest pot of tea . . ."

"If you don't stop fluttering and do what you're told, I'll tear your head off," Dolgorov said. "Guess what I'll use your skin for."

"Let's get cracking," Olafsson said. "I don't want to stay in this Helheim any longer than you."

They opened a hatch the least bit. While Paradoxian air seeped in, they dressed as warmly as might be, except for Harker. He intended to stand by the controls for the first investigatory period. The entering gases added a whine to the windnoise. Their helium content made speech and other sounds higher-pitched, not quite natural; and this would have to be endured for the rest of the journey, since the ship had insufficient reserve tanks to flush out the new atmosphere. A breath of cold got by the heaters, and a rank smell of alien growth.

But you could get used to hearing funny, Harker thought. And the native life might stink, but it was harmless. You couldn't eat it and be nourished, but neither could its germs live off your body. If heavy weapons had been needed here, they were far more likely against large, blundering herbivores than against local tigers.

That didn't mean they couldn't be used in war.

Trembling, eyes squinched half shut, tail wrapped around his muzzle, the rest of him bundled in four layers of kimono, Witweet crept to the personnel lock. Its outer valve swung wide. The gangway went down. Harker grinned to see the dwarfish shape descend, step by step under the sudden harsh hauling of the planet.

"Sure you can move around in that pull?" he asked his companions.

"Sure," Dolgorov grunted. "An extra hundred-fifty kilos? I can backpack more than that, and then it's less well distributed."

"Stay cautious, though. Too damned easy to fall and break bones."

"I'd worry more about the cardiovascular system," Olafsson said. "One can stand three Gs for a while, but not for a very long while. Fluid begins seeping out of the cell walls, the heart feels the strain too much—and we've no gravanol along as the first expedition must have had."

"We'll only be here a few days at most," Harker said, "with plenty of chances to rest inboard."

"Right," Olafsson agreed. "Forward!"

Gripping his blaster, he shuffled onto the gangway. Dolgorov followed. Below, Witweet huddled.

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Harker looked out at bleakness, felt the wind slap his face with chill, and was glad he could stay behind. Later he must take his turn outdoors, but for now he could enjoy warmth, decent weight—

The world reached up and grabbed him. Off balance, he fell to the deck. His left hand struck first, pain gushed, he saw the wrist and arm splinter. He screamed. The sound came weak as well as shrill, out of a breast laboring against thrice the heaviness it should have had. At the same time, the lights in the ship went out.

Witweet perched on a boulder. His back was straight in spite of the drag on him, which made his robes hang stiff as if carved on an idol of some minor god of justice. His tail, erect, blew jauntily in the bitter sunset wind; the colors of his garments were bold against murk that rose in the forest around the dead spacecraft.

He looked into the guns of three men, and into the terror that had taken them behind the eyes; and Witweet laughed.

"Put those toys away before you hurt yourselves," he said, using no circumlocutions or honorifics.

"You swine, you filthy treacherous xeno, I'll kill you," Dologrov groaned. "Slowly."

"First you must catch me," Witweet answered. "By virtue of being small, I have a larger surface-to-volume ratio than you. My bones, my muscles, my veins and capillaries and cell membranes suffer less force per square centimeter than do yours. I can move faster than you, here. I can survive longer."

"You can't outrun a blaster bolt," Olafsson said.

"No. You can kill me with that—a quick, clean death which does not frighten me. Really, because we of Lenidel observe certain customs of courtesy, use certain turns of speech—because our males in particular are encouraged to develop aesthetic interests and compassion—does that mean we are cowardly or effeminate?" The Trillian clicked his tongue. "If you supposed so, you committed an elementary logical fallacy which our philosophers name the does-not-follow."

"Why shouldn't we kill you?"

"That is inadvisable. You see, your only hope is quick rescue by a League ship. The courier can operate here, being a solid-state device. It can reach Oasis and summon a vessel which, itself of similar construction, can also land on Paradox and take off again . . . in time. This would be impossible for a Trillian craft. Even if one were ready to leave, I doubt the Astronautical Senate would permit the pilot to risk descent.

"Well, rescuers will naturally ask questions. I cannot imagine any story which you three men, alone, might concoct that would stand up under the subsequent, inevitable investigation. On the other hand, I can

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explain to the League's agents that you were only coming along to look into trade possibilities and that we were trapped on Paradox by a faulty autopilot which threw us into a descent curve. I can do this *in detail*, which you could not if you killed me. They will return us all to Trillia, where there is no death penalty."

Witweet smoothed his wind-ruffled whiskers. "The alternative," he finished, "is to die where you are, in a most unpleasant fashion."

Harker's splinted arm gestured back the incoherent Dolgorov. He set an example by holstering his own gun. "I . . . guess we're outsmarted," he said, word by foul-tasting word. "But what happened? Why's the ship inoperable?"

"Helium in the atmosphere," Witweet explained calmly. "The monatomic helium molecule is ooh-how-small. It diffuses through almost every material. Vacuum tubes, glass rectifiers, electronic switches dependent on pure gases, any such device soon becomes poisoned. You, who were used to a technology that had long left this kind of thing behind, did not know the fact, and it did not occur to you as a possibility. We Trillians are, of course, rather acutely aware of the problem. I am the first who ever set foot on Paradox. You should have noted that my courier is a present-day model."

"I see," Olafsson mumbled.

"The sooner we get our message off, the better," Witweet said. "By the way, I assume you are not so foolish as to contemplate the piratical takeover of a vessel of the Polesotechnic League."

"Oh, no!" they said, including Dolgorov, and the other two blasters were sheathed.

"One thing, though," Harker said. A part of him wondered if the pain in him was responsible for his own abnormal self-possession. Counter-irritant against dismay? Would he weep after it wore off? "You bargain for your life by promising to have ours spared. How do we know we want your terms? What'll they do to us on Trillia?"

"Entertain no fears," Witweet assured him. "We are not vindictive, as I have heard some species are; nor have we any officious concept of 'rehabilitation.' Wrongdoers are required to make amends to the fullest extent possible. You three have cost my people a valuable ship and whatever cargo cannot be salvaged. You must have technological knowledge to convey, of equal worth. The working conditions will not be intolerable. Probably you can make restitution and win release before you reach old age.

"Now, come, get busy. First we dispatch that courier, then we prepare what is necessary for our survival until rescue."

He hopped down from the rock, which none of them would have been able to do unscathed, and approached them through gathering cold twilight with the stride of a conqueror ■

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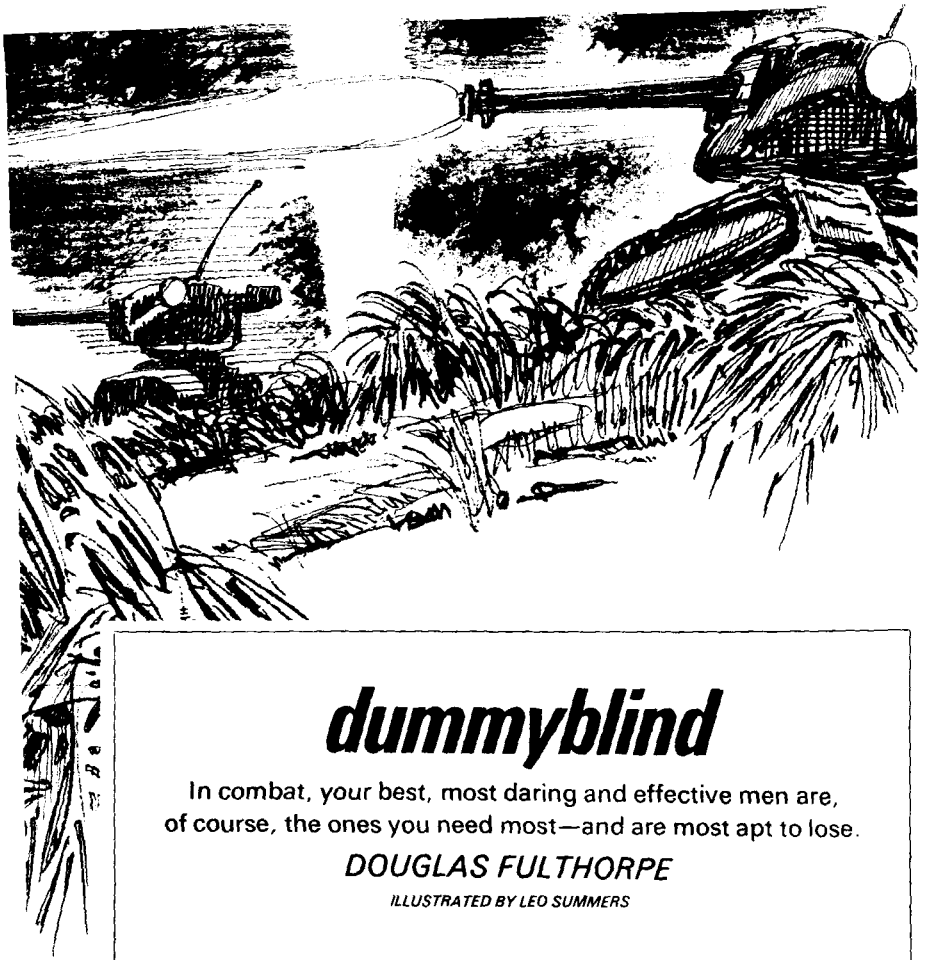

dummyblind

In combat, your best, most daring and effective men are, of course, the ones you need most—and are most apt to lose.

DOUGLAS FULTHORPE

ILLUSTRATED BY LEO SUMMERS

A spotter swished overhead through the dripping night, and Vandersen froze against the mud of the ravine wall. Beneath him, his six dummyblinds, straggling upwards from the racing streamlet, were also still.

Vandersen cursed mentally—you made the absolute *minimum* of noise on missions, if you wanted to stay alive, that is—and quickly debated whether to scramble back down the ravine into the tree-shaded safety of the deep, narrow cleft, or chance it where he was, hugging the clayey bank.

He chose the latter course, better to stay still than risk the spotter whipping overhead just as he dived for cover.

Thirty seconds passed. Vandersen chewed mechanically, swallowed saliva, and decided he would live a

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while longer. The spotter had evidently missed him. There was every reason why it should, of course. What little his camouflage suit gave away would be effectively dissipated, or masked, in the curtain of hissing rain.

He flipped his combat visor down, and took rapid stock of the situation. A square pitched grid of delicate green glowed before his eyes. Away up in the right-hand corner a small red cross nestled in a corner of two green lines. Down towards the bottom center of the grid was a green spot with white overtones. A minute arrowhead, protruding from the green spot, pointed roughly towards the red cross.

Four kilometers to go; another hour, with luck. He had been very lucky so far in covering two kilometers before the spotter crossed his path. His luck might hold; he'd pulled off harder jobs without so much as one exchange of fire. The odds were against it though. He'd probably see plenty of action before the night was out.

Time to part, dummyblinds He levered his chest from the bankside, checked his left knee from slithering on the wet clay, and lifted the dummymaster from where it hung at his belt.

His gloved fingers located and pressed the catch for the routecaster. Five thin, ghostly white lines appeared on his combat screen. Back at camp he had spent several hours poring over maps and estimating journey times over various terrains, before deciding on the operational routes for his five dummyblinds.

The five routes all diverged from the green spot representing his immediate location. Two of them later converged to end at the red cross; the other three, spread over the whole area of the grid, extended to the top of the screen. Between them the five dummyblinds should draw the enemy's attention from him.

On the top of the dummymaster cylinder was a ring of six small knobs. Vandersen gave each of five a full turn clockwise and then manipulated the combination, activated disk in the center. This sent an extremely short-range signal to the dummyblinds; a signal which would not reach hostile sensors.

A few seconds later the five dummyblinds whisked past him, already diverging on their separate paths. At close quarters and in broad daylight, a dummyblind was visible as a knee-high, neutral gray cone, riding on a jet of air and hiding an internal assembly of complex electromagnetic wave distortion equipment.

And most effective equipment, no doubt about that, thought Vandersen, peering after his vanished dummyblinds. At a range in excess of two meters a dummyblind bore a strong resemblance to a man wearing a camouflage suit; strong enough to dupe any man-made sensing device, anyway.

His dummyblinds should be out of the ravine by now. Already, length-

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ening fat and bright lines were superimposing on the faint ghost lines on the screen, indicating the precalculated positions of the dummyblinds.

He tipped the visor back up from his face, and hefted his pack, preparatory to climbing again. Just then the whine of an aircraft turbine cut through the sluicing rain.

Vandersen cursed and became immobile again. By the sound of its motor, this spotter, although it would be unmanned, was bigger than the tiny craft which had flown overhead minutes earlier. Bigger and fitted with better sensors to detect ground intruders.

The whine died away, and then returned as the spotter circled overhead. Vandersen stopped chewing and stood, tense and sweating, praying to an unknown God that the spotter would miss him and his dummyblinds.

The whine faded again and Vandersen began to claw his way up the bank, stumbling and slipping in the total darkness. His solitary remaining dummyblind bobbed obediently behind him.

Above and beyond the ravine was a flat expanse of scrubland. Lying prone in sparse, sodden grass, he lowered his combat visor and cautiously raised his head. As he had expected, the screen indication was negative. Nothing showed apart from the five dummyblinds, the target and himself. The positions of the target and dummyblinds were all pre-calculated, the target was far beyond the range of the feeble sensors built above his visor, and the dummyblinds were specifically constructed to give a minimum of indication.

Under good weather conditions and on open terrain, his sensors had reasonable range, perhaps a couple of kilometers—tonight he doubted if they'd pick up anything more than fifty meters away.

He turned slightly to align his indicator arrow with the red cross. A quick glance through his infrared sensitive visor showed only a sea of pale, lancing streaks of rain.

Shrugging the visor upwards, he palmed rain from his numbed features and squinted blindly into the darkness. No more loitering, he thought grimly, and, rising to a half-crouch, he set off into the storm.

"You are to immobilize enemy field command post Mirabel, and return to base." The brigadier general's manner was curiously offhand and preoccupied and Vandersen had the impression he felt he had more important work to attend to.

"Yes, sir."

"You'll do it. I have faith in that." Again, Vandersen sensed that his commander's mind was on other matters. He wondered how many times the brigadier had sat in this steel-walled operations command room, mouthing such utterances to men embarking on suicide missions.

"Colonel Vandersen, you are now

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a veteran of ninety-four successful missions." The brigadier general's taut features jerked into a smile, and Vandersen noticed with slight irritation how his right hand half-clenched and wandered over his plastic topped desk towards the papers and tapes in the in-tray. "I have recommended that, after this mission, you be given three months leave followed by transfer to a commando training camp." His right hand raised to silence Vandersen's attempted interruption.

"No arguments, Colonel. With your knowledge and aptitudes, you are worth even more behind the lines than as a combat soldier."

They shook hands and Vandersen strode from the room. Just before the orderly closed the door, Vandersen glanced around. The brigadier's tall form was bent over his desk, his attention once more fully devoted to his stereo maps and requisitions.

The mission was to knock out command post Mirabel. Although this would not impair the individual fighting power of the half dozen unmanned tanks and support weapons defending the six-kilometer stretch of the front covered by Mirabel, it would render them ineffective as a cohesive fighting force.

The war had dragged on for six weary years. Half the world's major cities were radioactive dust; whole populations were sterile and disease-ridden, but the armies in the field were far from beaten, and from the underground factories spewed an endless variety of sophisticated tools of destruction.

The western theater had a fluid front of roughly two thousand four hundred kilometers, defended mainly by mobile, unmanned ground units operating under localized field command. A good many kilometers behind the line lay the heavy armored divisions and infantry units.

If Vandersen succeeded in destroying Mirabel, unmanned units of his own side would occupy the strip of territory. This might, or might not, provoke retaliatory action, ranging from the incursion of a solitary suicide commando to a full scale assault by hundreds of tanks under missile cover. Either way, that was war . . .

If he succeeded. *When* he succeeded, Vandersen corrected himself. Vandersen, the most decorated shock trooper in the America Corps, the hero of a hundred exploits—sabotage, undersea infantry warfare, assassination. His expressionless scowl beckoned from a million propaganda posters, from magazine covers and history texts.

On television his adventures thrilled the war-fevered denizens of the city warrens of the late Twentieth Century. Doctored fact and fiction were intermingled. Frequently the omitted facts were more starkly horrific than any highly spiced dramaplay.

Three whole months of leave after this mission. He'd wangle leave for

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Mara from the factory, and together they'd find a quiet beach somewhere far from the war, a haven of peace divorced from parade grounds resounding to the stamp of drilling men, away from munition works, fortress cities in the depths of the earth, and hospitals crammed with post-radiation sufferers. Away from all the rotten filth that was war.

Three months of lazy afternoons on sunny beaches, and evening strolls through cool woodland. A welcome change from patrolling the seared wastes which were once the populous regions of the homeland, never sure whether you were hunter or hunted, never knowing when violent death might take you . . .

Vandersen halted. The ground beneath his feet, rock covered here and there by black, peaty soil, was beginning to slope downwards. He'd traveled perhaps three quarters of a kilometer since releasing the dummyblinds, and he'd be dropping into the next valley.

He could remember the map perfectly. Before him was a fairly deep valley with a broad stream, more of a river, wandering through a patch of not too dense woodland, mixed deciduous and coniferous trees. It might be worth another glance at the map, though, he decided.

He knelt on one knee, noting automatically and with dismay that the rain was thinning, and pulled down his combat visor. Immediately ahead, the hillside beyond the stream showed as a large misty blur on the screen. On the hillside was a small, slowly moving white patch.

Damn, Vandersen voiced silently. A quick glance through the infra-red viewer showed a telltale trace of color, probably from a turbine exhaust duct. A tank lay squarely in his path.

It had not seen him. If it did, approximately one half second after being spotted he'd be sprayed with high velocity antipersonnel pellets, followed by a brace of blast missiles.

He flattened against the wet earth, his right hand resting on his laser-pistol. The rain had thinned to a fine drizzle, seeping down through the surrounding darkness.

The tank, as indicated by his combat screen and infra-red viewer, was now stationary. It occupied a commanding position for a considerable area around and in front of the hill. He had a chance of escaping detection by simply crossing the river and scaling the hill, for his camouflage suit was designed to produce a chameleon-like effect of mimicking its surroundings in all respects, acoustic, olfactory and electromagnetic.

The nearest thing to a suit of invisibility which military science could devise, it was, however, by no means absolutely effective. Vandersen began to curse; then checked the futile gesture. He had no intention of ending up as mincemeat, or charred cinder, on this hill or anywhere else, so he hesitated.

If he detoured away from the hill

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he would add kilometers and precious time to the operation, and time was something he couldn't spare. He could follow the river through the woodland to a point where a tributary joined, then work his way up the tributary valley, behind the hill where the enemy tank waited. There was a fair chance that the wood was patrolled . . .

Abruptly an explosion sounded to the left and slightly forward of Vandersen. The first of his dummyblinds had been eliminated, and his decision made for him. What had been a grim game of hide and seek was now a hunt of deadly ferocity. All units would be on combat alert, and would shoot at anything that moved, or registered, on their various sensors.

He heard two further explosions as he groped his way down through soaked bracken, pistol at the ready. It was probably some luckless rabbit or field mouse.

Silently he slipped into the cover of the trees, and changed course to match that of the river. He did not want to penetrate too deeply, just in case there were enemy patrols around.

The combat screen, set for close range, was a meaningless jumble of overlapping and superimposed microwave images from the surrounding trees. After less than a minute Vandersen had to admit partial defeat. The wood was totally impassable under either visual or microwave control. He had no option but to resort to acoustic tracking, and rely on the trees to absorb, or break up and scatter, all incident sound.

The going was much easier as he picked his way between the tree trunks shown as blips of reflected sound on the screen. Even so he frequently stumbled on the uneven ground, tripped over half-exposed roots, or was forced to backtrack when he found his way barred by thickets of tangled shrubs. Once a spotter passed overhead, without causing him much concern. Frequent explosions in the far and mid-distance were a further reminder of the activities of his hunters.

He couldn't be more than two hundred meters from the confluence of the river and its tributary. Already his position would be hidden from the waiting tank, by the curve of the hill.

Just then he heard the first faint thrashing sounds ahead. Instantly he cut off the acoustic tracker, for at close range the emitted sonic pulses would display his position like a beacon.

The combat screen, energized for sound reception only, indicated clearly the approaching object. Hidden behind a tree trunk, with only the tips of his visor's sensors exposed, Vandersen waited while the enemy minitank trundled by.

After the last thrashing sounds had faded into the night, he continued his journey through the dark wood. Through the patter of rainwater

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dripping from leaves and branches, he heard the slow murmur of flowing water.

The *ping* of anti-personnel pellets saved his life. As the first of a stream of tiny projectiles whipped no more than a handspan wide of him, he dived headlong to his left. A second later a blinding white gush of flame roared through where he'd been.

Flinging his visor from his face, he scrambled on, desperately seeking cover. Before he'd taken two steps, a terrifying barrier of white flame appeared an arm's length ahead of him. His suit and the camouflage paint on his face saved him from radiant heat burns, but they would be no protection at all if the fiery jet caught him.

The burst of flame died abruptly. He stilled the dummyblind—he didn't want it tagging along, getting under his heels while he fought for his life.

He counted three and then scurried on without changing course. The orange-white tongue lashed out again, this time aimed far behind him. For brief seconds, in the flaring brilliance shed by the flame-thrower he glimpsed his adversary against a background of straight and dark tree trunks.

The thing hunting him was a walking nightmare, a skeletal creature of dull, rustless steel and hidden microcircuitry, a parody of mankind with a fuel-cell for a heart and a computer for a brain, electro-hydraulic drive units in place of muscles and a belly full of low-gel napalm.

Robotroop units had been used from time to time with limited success. As an infantryman the robotrooper was of indifferent quality, principally through inherent lack of initiative and a disastrous tendency to fight anything within range, including its own comrades, human and automatic.

Here in the darkness, however, pitted against a single man, it constituted a dangerous and almost indestructible foe.

It had lost contact with him when he dived out of sight, and was hopefully probing in various directions with the flamethrower. Vandersen knew he had scant seconds before missiles began to rain down, for the robotrooper would be beaming information back to Mirabel.

Before the glare of the flamethrower died he lobbed a couple of frag grenades at his enemy. The first overshot and exploded harmlessly on the ground, the other hit the robotrooper square on its upper torso, bounced a little and tumbled to explode at knee height.

As Vandersen had feared, the robotrooper seemed completely uninjured by the grenade. All he had hoped to do was destroy some of the more vital sensors which were distributed over the thing's body.

He could not understand why no missiles had arrived yet. He was well within range of the tank on the hillside. Just then he heard the far off

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thrashing noise of one or more approaching vehicles. So that was it. The human soldiers at Mirabel had decided to bring in help for the robotrooper.

A lance of flame suddenly shot out from the flamethrower in the thing's lower torso, and Vandersen glimpsed it with its arms outstretched. It turned methodically, its left arm gun spraying A.P. pellets while the other launched body-heat-seeking missiles at intervals of roughly four seconds.

He had to get away before help came for the robotrooper. For that matter it would only be a short time before it caught him with its guns or flamethrower.

His own missile launcher was too cumbersome to use at close range against his weaving, pirouetting opponent, and his laser pistol was too weak to damage it severely. If he could give it a thermal grenade at very short range. . . . But how? He had seen his frag grenade bounce off to explode harmlessly. If he could somehow place a thermal grenade in contact with the thing's bulging head, or lodge it between head and shoulder . . .

He flattened lower against the forest floor as a randomly aimed stream of pellets passed overhead, cutting off a small branch of a tree which fell lightly onto his shoulders.

The slight impact seemed to plant the germ of an idea in his mind. It took moments only to knot the end of his thin, high-strength scaling cord around the knobbed handle of a thermal grenade. Gently and soundlessly he picked up the broken branch and threw it over the robotrooper's head.

He didn't hear the branch hit the ground, but his adversary did, and whirled instantly in the direction of the noise, a tongue of roaring flame and streams of pellets and missiles lashing at its imagined prey.

Vandersen flitted towards the robotrooper. He had to get nearer, as close as he could, in fact, before the mechanical soldier sensed him. When he was little more than six meters from it he yanked the fire pin from the grenade and lobbed it towards his enemy.

His aim was good. As he hit the dirt he saw the thermal grenade, outlined against the glare from the flamethrower, fall beyond the shoulder of the robot.

At the impact of the scaling cord on its shoulder, the robotrooper abruptly stopped firing. In the total darkness and silence, Vandersen heaved gently on the scaling cord. At best he had about a second before the robotrooper assessed the situation and began blasting again.

The cord became suddenly taut, just as, with a frightening *whoosh* of flame, a missile shot from the robot soldier's right arm. Vandersen watched through a darkened visor, watched a brilliant white ball of light appear at head height in the direction of the robot.

He paused only long enough to re-

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activate the dummyblind on a course which would take it across the river some distance downstream; then he was on his feet, running past the burning robotrooper, sprinting on through the woods. He had no need of his various seeing aids, the trees and fern around him were clearly visible in the blinding light from the still burning thermal grenade.

He looked around once as he ran. The robotrooper was still on its feet, but was hardly in operational condition. Its entire right shoulder had melted in the heat from the thermal grenade, the arm had fallen off, and all that remained of its head was a small stump of near incandescent metal. It staggered around blindly, shedding streamers of molten slag.

Then the world seemed to explode around the running man. At least half a dozen missiles must have landed in the vicinity of the stricken robotrooper. A giant fist of blast picked up Vandersen, as a child might snatch at a toy soldier, and hurled him against the base of a tree trunk.

He lay dazed and injured as earth and splintered timber showered around him. There was no waiting though, not if you wanted to survive. He dragged himself to his feet, and tried to forget the devastating ache in his head. His only chance was to get across the stream and out of the wood before the minitanks closed in on him.

Both his arms were injured; the right one was numb from the elbow down, and as he tried to raise his left hand the grating of broken bones forced a stifled shriek of agony out of him.

His right hand was slippery with blood, but he managed to pull down his combat visor, which, miraculously, was still in functional order. On the screen three white splotches glowed intermittently through the trees, about a hundred meters behind him. They were heading towards him, and in his present condition, hot and bleeding, he hadn't a chance of avoiding detection.

Apart from his arms, he was, as far as he could tell, uninjured, but he couldn't carry on without some treatment for his wounds.

A small flat pack of quicksalve hung at his belt, and by inserting the nozzle pipe up the sleeve of his suit he was able to spray most of his left arm. It wasn't easy to handle the pack with his left hand, but the pain of his broken arm was already beginning to recede, and he managed to repeat the treatment on his right arm.

Then he sprayed the pack itself, to mask all trace of blood.

The salve would initiate healing processes locally, but, more important, it would give him a chance of evading the olfactory sensors of his pursuers.

The stream was visible only as a blank stretch in the darkness of drizzly night. The level was rising after the heavy rain, and by dawn the stream would be a racing brown tor-

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rent. Vandersen hesitated briefly, undecided whether to cross at this point or carry on downstream before crossing.

An ominous clank and screech of steel treads, from among the trees behind him, made his decision for him. He waded in, wincing at the chinking scrape of gravel underfoot, but not slowing down, for the pursuing tanks could only be seconds from the stream.

Abruptly the whirr of a spotter sounded above him. He stood absolutely still, waiting for the sound of the motor to fade. It didn't; the spotter was hovering almost directly above him, and as he waited the broad conical beam of a small searchlight suddenly shot from the spotter and bathed him in light.

He took a quick shot at the light source, missed, and then stuck the pistol back in its holster before diving under the water.

It wasn't really swimming; he was using his good right arm and doing a scissor-kick with his legs, but he kept bumping against the streambed, and every few seconds a vagary of the current would bowl him over, or would twirl him end for end. His suit and visor had automatically sealed at all exposed points, and the oxygen tank in his pack was meeting his respiratory needs.

His erratic course downstream was traced on his combat screen, although the screen sensors could pick up nothing while he was underwater. Roughly two hundred meters downstream of the point where he had entered the water, the stream was considerably broader and shallower. The patrolling tanks would probably be waiting, expecting him to crawl out at this point.

Just before he had covered half the distance, he swam hard for the far bank. As soon as the water was too shallow for swimming, he cautiously raised his visored head above the surface.

Eight enemy ground vehicles were registered on the screen, within little more than a stone's throw. Four of them were spaced along the bankside he was lying under, two were on the other side, and the remaining pair were standing in the shallows downstream of him. Overhead three spotters weaved intertwined figure-eight patterns.

The precalculated position of his sixth dummyblind was about fifty meters short of the shallow stretch of stream. The chances were it had already been eliminated, though. Cautiously he raised his visor from his face.

The entire stream and flanking woodland were bathed in brilliance from the swinging searchlights of the minitanks and spotters. He could imagine the excitement in the enemy HQ, with personnel clustered around the visual and sensor screens, straining for a glimpse of telltale movement, or patch of color.

The water was warmer. For sev-

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eral minutes he had lain with his visor just breaking surface, studying with grim fascination the movements of the minitanks and spotters on his combat screen. Now he could feel an unmistakable warmth in the water washing over his limbs.

Two of the minitanks had entered the water a little upstream of the point where he had left the bank. So that was it; they intended to boil him alive by pumping in heat, probably from a nuclear source. The water was now unpleasantly hot, and at best he could stand it for only a minute or so longer. Then he must emerge to almost certain death.

There was very little chance of evading detection in the glare of the enemy's searchlights, which contained every spectral band the sensors could handle, from microwave to the far UV. Good as his camouflage suit was, it could not duplicate its surroundings perfectly under brilliant illumination.

He had no alternative to trying, though; his flesh was already prickling. Easing upwards his visor, he began to crawl onto the bank.

Dense clouds of steam, from the near-boiling water, drifted through the probing searchlight beams. Fine, it would give him at least a ghost of a chance.

One of the minitanks across the stream switched its beam to the opposing bankside. The beam picked its way carefully along the stream edge towards Vandersen, who, with slow but desperate movements, was trying to inch his way clear of the stream.

The beam wandered closer to the sweating Vandersen. He became completely still as the brilliant disk of light moved within an arm's length of him.

Abruptly the blinding beam leaped away and sped across the stream. All the beams were moving now, to where, caught squarely in a spotter's beam, a manlike figure jinked and twisted desperately.

Watching from the darkened bankside, Vandersen could hardly believe his luck. The dummyblind was responding to the stimulus of the light beams, and was behaving just as would a human fugitive in similar circumstances.

Twice the dodging, running form escaped the probing white pencils, then no fewer than six beams transfixed it in a pool of blinding radiance. A jet of fire from a minitank hit the dummyblind, almost bowling it over.

Hopelessly the burning form plodded on. Another fiery lance from a second minitank impaled it and the dummyblind, now a quite unrecognizable flaming mass, flopped sideways. Almost contemptuously a minitank loosed a cannon shell which blasted it into a shower of incandescent debris. Vandersen missed the finale of the grim dramaplay. By then he was deep in the wood, moving easily and surely under acoustic control.

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The rain had returned, and was pounding with chill vigor on the man lying full length on wet bogland. Although his suit was waterproof, Vandersen was very cold and weary. He had long since ceased to feel emotions when on mission, unless the everpresent undercurrent of fear could be classed as such.

This was how he wanted to be. There was a difference between fear and panic. Fear lent you a healthy respect for the enemy, and discouraged foolhardiness, while panic caused you to make lethal mistakes.

Controlled fear went hand in hand with caution, and it was this which had enabled him to survive almost a hundred missions, and now bade him lie here in the rain, considering the final phase of his assault.

He had halted on a slight rise, to scan the bare kilometer of grassy plain between him and enemy command post Mirabel. Not that there was anything to see; the darkness and lashing rain took care of that. The combat screen was no help either. The only thing registering upon it "live" was himself. The known position of Mirabel was indicated; but the command center itself made no impression on the screen sensors. As for enemy tanks, robotroopers or human personnel, there could be a whole army waiting for all the screen knew about it.

Still, if he could not see the enemy, they had even less chance of detecting him.

If he waited until dawn, Mirabel would present a fairly easy target for his hand rocket-launcher. The snag was that the enemy's exploder-interceptors would effectively screen out most of his missiles, and he would almost inevitably die within seconds.

No, this was the best way, in almost total darkness under the worst of weather conditions. All he had to do was get close enough to Mirabel to lob a fusion bomb among the bristling probes and transmitters on the roof of the command post, and then sprint madly to get clear in the four seconds before the ensuing miniature nova illuminated the area in a premature sunrise.

He had made good time, considering the episodes with the robotrooper and in the stream, and the detouring path he had taken to throw off his trackers. His two dummyblinds, if by good luck they were still operating, would now be one kilometer from Mirabel, approaching from south southwest and east respectively, while he spiraled in from the north.

The visor pulled down over his face, he moved off at a crouching lope, for target Mirabel . . .

Despite the poor conditions, the combat screen was useful; twice it helped him pick his way through mine fields, the first conventionally below ground, and the second consisting of a scatter of aerial mines, wandering apparently aimlessly at anything from ground level to chest height.

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If a spotter sensed him now, he was finished. There was no cover at all on this flat tract of moorland, and he hadn't the slightest doubt that the least indication of any intruder here, barely a stone's throw from command center, would invoke a deluge of artillery, or missile fire, from the center.

It wasn't a spotter he encountered, but a tank. One moment his screen was clear; the next there was a large white patch almost touching the green spot representing himself. He flipped up his visor, at the same time diving flat, just as a huge black shape loomed out of the rain.

There was not even time to roll aside from the path of the tank. He had a brief impression of a dark mass rushing at his face, coupled with a blast of cold air; then the heavy but flexible pressure skirt of the tank struck his visor with stunning force, gave at the impact, mounted his head and raked over his body to his heels.

His senses half beaten from him, it seemed to Vandersen that he had strayed into a tornado. Howling winds lashed and pummeled his sprawled form, threatening to rip his suit and pack from his back.

Realization came swiftly; he was underneath a hovertank. With understanding came the horror of knowing what would happen if the tank suddenly cut its jets. He had a nightmarish vision of the tank settling lower as the jet died, settling until its underside structural members touched the ground, crushing him like an insect.

The tank had stopped for some reason, and for all he knew it might cut its jets at any instant. He had no intention of waiting to find out.

It was totally dark under the hovertank, and his combat screen was blotted by one huge white blur—the proximity of the tank had overwhelmed the screen sensors. He began to crawl.

He inched his way through the black maelstrom. After what seemed a long time he noticed that the blast of air was becoming predominantly horizontal. He crawled swiftly in the direction of the airstream, and experienced grim relief when his knuckles rapped against the pressure skirt.

It was then the idea came to him. On finding himself under the tank, his first and instinctive reaction had been to escape. Now he was wondering if he could use the tank strategically.

If he guessed right, the tank above him was a Mark 10 Hector, a medium-sized job with attack-missiles, heavy cannon and twin rotors mounted fore and aft in a figure-eight arrangement. She was heavily armored with supersteel, but not on the underside, not on the small deck areas connecting the two "O"s of the figure-eight.

Sweat-drenched, half cursing and half praying, he wormed along the pressure skirt, until he located the strip of plate he was seeking. Pre-

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cious seconds passed while he fumbled in his pack for the electron beam gun. The gap between the discharge ducts tapered to a minimum of just over the girth of his hips. He managed at the third attempt to wedge himself in the gap, clear of the ground.

The electron beam gun was a favorite tool for partisans, who, after approaching a tank from a blind angle, used it to burn a fist-sized hole into which they would stuff a couple of grenades, with satisfying effect.

The hole which Vandersen trepanned out was much larger, yet after only six seconds application of the gun the heavy metal disk swung down and dropped past his hand.

The control compartment into which he crawled was cramped and noisy, a metal-walled cell containing smaller metallic cells from which energized circuitry, pulsing fluids and clicking cams controlled the tank's multiple functions.

It seemed incredible to Vandersen, glancing around in the light of his visor beam, that when the tank was under hand control, three men would be crammed in this tiny box. There was so little room they had to phase their breathing . . .

Most of the control units were double-banked, and, in the event of failure, activation passed automatically to the sleeping unit. Vandersen's expert eye was searching for the equipment controlling the heavy cannon. The tank was under way again at a steady twenty knots, but the intruder was not concerned; he was fairly certain the vehicle was on local patrol, and a glance at the combat screen showed that it was following a circular route around Mirabel.

The journey was in no respect comfortable; every change in contour or direction made the control capsule heave and joggle. The designers had chosen the easy way, and had lavished thermal, acoustic and vibration insulation on the equipment, leaving the rest of the compartment unsprung and cruelly exposed to the fierce heat and endless scream of the turbines.

Comfort, however, was the least concern of the crouching commando. He worked quickly and surely on various standby units. Frequently he checked his work, and twice had to correct mistakes. First, he fed Mirabel's coordinates into the tiny gun-laying computer, and then he arranged for fragmentation and thermal shells to be fired alternately at maximum rate, three rounds per second, and at maximum elevation.

The tank gun would lob shells onto the top of the enemy control center, where the detector probes and control aerials clustered thickly. Vandersen had little doubt the tank would be blasted into molten fragments seconds after it failed to respond to the continuous control monitor signal from center Mirabel, and defensive exploder-interceptors would eliminate a good fifty percent

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of the bombardment. It could nevertheless act as a useful decoy to occupy the enemy's attention while he approached close enough to throw his fusion bomb among the control probes.

Obtaining a time-delay unit proved the most formidable obstacle to the completion of his work. The most suitable item of equipment was part of a system which automatically shut down the tank's main drive unit at irregular intervals, for a brief period of acoustic monitoring of the locality.

The standby item was awkwardly positioned, and Vandersen expended priceless minutes in removing it and then installing it in its new location. Finally he set the timer to activate his pirate control system in fifteen minutes time.

This would allow him sufficient time to spiral in to attack range just before the tank launched its own rebellious assault on Mirabel, at the same time as his two dummyblinds, if they still survived, passed close to the enemy command post. Then he would attack.

The tank was still following a roughly circular course around Mirabel when Vandersen dropped through the hole he had cut in the lower deck. He lay motionless on the ground for a full minute as the muted scream of the tank's gas turbines died in the rain-filled darkness.

Crouching on mossy bogland, he adjusted the position of the fusion bomb so that the top end of the handle was just below the opening in the pack. When he needed the bomb, all he would have to do was ease the pack open, reach over his shoulder to pull out the bomb, and then insert the firing pin. The bomb would detonate four seconds after he released the safety button in the handle.

He was shivering and half numb with cold beneath the wet camouflage suit, when he pulled himself to his feet. Fine, it reduced still further the chance of the enemy sensors picking up his body heat. Rain spattered off him as he moved in at a slow lope towards his target.

The screen showed nothing save a vague and barely discernible roiling, an indication of the local storm pattern. He hoped there was nothing else shielded by the curtain of rain, waiting to blast any intruder.

Now there was less than two hundred meters radial distance between him and Mirabel. In just five minutes the hovertank would swing its turret to bear on the command center, and he would be waiting in the shadows . . .

"FREEZE, VANDERSEN!" The bellowed words sounded metallically. Simultaneously six spots of light appeared around him on the combat screen.

"One move and you're dead," the loudspeaker voice continued, He had stood absolutely motionless from the moment when the voice first sounded. There were probably a

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dozen weapons poised to annihilate him at his slightest move.

"Lift your visor—slowly." The voice was very precise and careful. He obeyed, moving like a man in a slow-motion film. As the visor raised, brilliant lights dazzled him. He was ringed by searchlights.

He stood, bathed in light, unable even to see his foes, human or mechanical, who watched him from the darkness beyond the zone of brilliance.

Dumbly and wearily he followed the commands of the disembodied voice. The visor unit was deposited on the ground, followed by his laser pistol, belt and pack. Finally he unzipped his camouflage suit and began to peel the garment from his shoulders.

The faint prick of a high velocity, anesthetic spray stung his neck. As his knees buckled, the blinding lights suddenly dwindled and receded into the dark tide sweeping over him.

"You did fine, Colonel Vandersen, just fine." The prison camp commandant was, like Vandersen, a big man. Like Vandersen, he was also intelligent. There the resemblance ended, Vandersen's hard, unsmiling and whip-taut manner contrasting starkly with the other's jovial and relaxed air. But for the russet combat tunic, with amber collar tabs and shoulder badge depicting a key, he might have been, not a soldier and jailer, but a successful business man negotiating a deal in plastic ovenware, or some other everyday commodity.

"I believe you *are* Colonel Vandersen?" he continued gently; "Colonel Eric Vandersen?"

"As stated on my identity disk, Eric Vandersen, European army colonel, serial number 235 . . ."

"That's all right, colonel," the commandant interrupted, "I'm not an interrogator. This is just an informal chat between, I suppose you could say, the best of enemies. Besides, since you are Vandersen, we know all about you."

For all his geniality, there seemed something false in the commandant's manner. Vandersen wondered why, in making his last remark, he had found it necessary to lower both his eyes and his tone of voice.

He drew deeply on the cigarette the commandant had given him two minutes earlier. He was puzzled. He had been unconscious from the time of his capture until his guards had revived him a couple of hours ago. Since then they had made no attempt to interrogate him. Instead they had allowed him to shower, had treated his wounds, had clothed him in new prison fatigues colored fluorescent sky blue, and had given him a plain but welcome meal.

"Thank you." His tone was unintentionally laconic. "So far the treatment I have received has been astonishing. The best I had hoped for was a whiff of noxene, or an A.P. pellet. Am I in the hands of the Americans, or the British?"

"Neither, we're Canadians, ac-

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tually. My name is Stonebanks." Some of the joviality faded from his face, and it seemed to Vandersen that something sick came into his eyes. For a few moments his attention was distracted, and he glanced around his office as though seeking inspiration from the light gray walls and darker gray furniture.

"I'm not an inhumane man, Vandersen. I wouldn't be talking to you like this if I were."

"Why are you talking to me, then?"

The other lowered his eyes again. "I have . . . er . . . certain information to give you."

Vandersen wondered what was behind the careful hesitancy of the Canadian officer. "Which, no doubt, you are willing to disclose at a price. I'm listening, commander."

"Uh . . . look, Colonel Vandersen, I hold no animosity for you." His mouth twisted in embarrassment. "In fact, I don't even regard you as an enemy, although I am obliged to intern you."

Incredible as it was, it seemed to Vandersen that Stonebanks really believed the nonsense he was talking.

"Turn the other cheek, eh, commander? Love thine enemy as thyself."

"I said I don't regard you as an enemy, which is different from loving your enemy." Stonebanks seemed at a loss for words. There was an uncomfortable pause while he toyed with the switch of the dictowrite unit on his desk. He gave an unconscious half-sigh.

Vandersen waited patiently. He reasoned there was little else he could do, not with two guards standing behind him with sub-laserguns at the ready. There was something definitely irritating in the commandant's manner; an evasiveness, and something else which he couldn't put his finger on, but which was vaguely familiar.

"We thought we had you in the wood, you know." The commandant was smiling again. "The robotrooper had you pinned down and the minitanks were only meters away. That was a clever trick with the thermal grenade.

"There again; we had you pinned down at the river, till your dummyblind came on the scene. We were fooled all right until we got a spectrographic indication when we blasted the thing. You were hiding in the river when we boiled it, weren't you?"

"I have given you my name, rank and serial number, and that's all you will get, Commander." Vandersen felt better now that the pattern was emerging. Soften him up a little with compliments and sympathy; then carry on with a few questions.

Stonebanks did not seem to have heard his prisoner's curt reply. "Yeah, your dummyblinds gave us a time, sure enough. Every time we spotted one it tied half our force down for several minutes. And burning your way into that tank, now;

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that was something. Still, you're Vandersen, and that was just the sort of trick you might pull.

"But fixing that tank the way you did—! There was the whole of the duty watch at Mirabel standing gawking at the screen, watching them bring you in unconscious. Then our own tank suddenly swings its turret to bear on the command center—"

"You mean it destroyed the target?" In his excitement Vandersen jumped from his chair. A big hand grabbed his collar and rammed him back down. Any thoughts of retaliation he might have had were stillborn as the muzzle of the other guard's lasergun pressed coldly into his neck.

"I mean just that." Stonebank's voice held admiration. He waved the guard away from Vandersen. "The command center's defense systems would automatically engage an intruder, but would require a direct order from human personnel before firing on our own tank, and by the time our dreaming warriors had their fingers on the buttons the tank had got off about twelve shots, four of which got past the interceptors, and that was the end of Mirabel as a command unit. Our reccy planes, flying over the area just after dawn, reported that your forces were in full control.

"Well, what do you say? Oh, come on man. You succeeded brilliantly, and I have nothing but respect for you."

"What do I say?" Vandersen paused, his mind reaching after the fading vision of Mara, himself and their retreat from the cares of war. In its place there stretched the bleak vista of months, or years, of captivity. "Thank you for telling me this. It is worth knowing."

There was, however, still something bothering him. There were things he did not understand; technical matters, which Stonebanks might explain. There was something more than technicalities, though; an undefinable but persistent falseness in the whole situation.

"Commander Stonebanks, as a soldier and as a man, I am grateful for what you have done for me today." He paused as the other nodded in acknowledgment. "Two points puzzle me, however—" Was it his imagination, or had Stonebanks stiffened slightly at his words?

"How did you nail me with such precision and certainty, Commander, in that black wilderness? I would have thought it easier to find a grain of soot at the bottom of a coal mine, then get a fix on me in those conditions."

"A pressure-sensitive grid, Colonel, lying in a ring around Mirabel," Stonebanks replied, his slightly apprehensive air giving way to mild triumph. "The latest thing from our weapons designers. A grid just below soil level, which gives a characteristic signal when a man walks over it, a signal different from that produced by a dummyblind gliding across it.

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"As soon as they got an indication at Mirabel, they swung every sensor they had onto you, and with that sort of amplification they couldn't fail to pick you up. You know the rest of the story . . .

"Fair enough. My other question is, how did your people know who I was?"

That was the question. Almost before he had spoken the look of evasion came to Stonebanks. Not only evasion, however; there was something else, a preoccupation with other thoughts. Preoccupation. Vandersen suddenly realized what had haunted him since the discussion began. Stonebanks had the same air of evasion, hesitancy and preoccupation as the brigadier who had sent him on the mission. An air of unease, of concealed knowledge; of shame, almost.

Stonebanks's eyes were not on his. "It gets no easier," he muttered, half to himself. "I'm going to be blunt, Colonel. What would you say if I told you you were not Vandersen?"

"I'd say you were mad."

"Exactly. Colonel, I'd like to ask you something. What do you know about psychotrans surgery?"

Vandersen was becoming tired of the air of mystery which accompanied every utterance of Stonebanks, but he had to smile at the term used.

"It sounds like something from one of those TV space shows before the war took over every channel. No, I've never heard of it." He shook his head as Stonebanks pushed an opened packet of cigarettes towards him.

The commandant took one for himself, picked up his lighter and thumbed aside the small switchplate. Two seconds later the tiny disk exposed glowed bright red as the lighter's fuel cell supplied electrical energy.

"Personality transfer, then," said the commandant. He replaced the lighter on the desk. "Have you heard of that?"

"Heard talk of it, that's all."

"More than talk, Colonel; an established surgical technique in widespread military use."

"Commander Stonebanks," began Vandersen, annoyance rising in his tone, "are you telling me somebody's been monkeying around with my mind?"

"More than that. I said this was never easy."

"What the hell are you talking about?" Vandersen was on his feet now, lunging towards Stonebanks. All he intended was to ask the man to stop talking riddles; to pick on someone else to toy with.

The guards thought otherwise. The quicker of the pair caught Vandersen's right shoulder and spun him around. A foolhardy act, as he realized when he recovered consciousness an hour later.

The heel of Vandersen's open hand slammed with practiced ease under the nose of the guard, snap-

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ping back his head. A hard first in the solar plexus ended the execution.

The other guard's lasergun was swinging up with deadly intent, just as Vandersen dived at his knees. The gun went spinning and guard and prisoner rolled together briefly on the planked floor. Then the guard was doubled in agony and Vandersen was crouched, the sublasergun in his hands leveled at the commandant's throat.

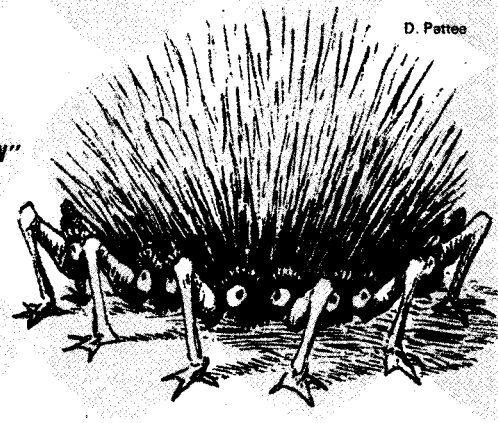
"Now, Commander," he rasped, "the truth—" He broke off at the sound of heavy boots in the corridor, followed by a thunderous hammering on the door. "Tell them to stay there, or you'll have a new mouth—in your throat."

Stonebanks had not moved during the brief struggle. All geniality gone now, he was white-faced, but his hands were flat and steady on the paperstrewn desk. His mouth and eyes were hard slits of concentration as he faced Vandersen.

"Guards," he shouted. "This is a secondary alert. An armed prisoner is in my office; do not enter.

"All right, Vandersen. I tried to break it to you gently. But you want the truth. Five years ago the medical branch of the European Weapons Ministry perfected a surgical technique with which the personality of an individual may be transferred to another person. The personality pattern and all memories of the recipient are first removed, to be replaced by those of the donor—"

department of diverse data



SCHIZOPHRENIUS SPINOSUS MULTIPLEX or "ANIMATED PINCUSHION"
E.T. from Canopus VII. Tricky and unpredictable. Hard to decide which way he's going to jump. Apparently hard for the E.T. also.

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"You're lying!" Under a film of sweat, Vandersen's face was mottled yellow from the re-awakened pain in his shoulder.

"In addition, physical and neurological qualities such as agility, sensory response and reflex activity are largely replaced. Subjectively and, to a slightly reduced degree, in terms of performance, the recipient becomes a duplicate of the donor."

"I don't believe you. This is some filthy trick to brainwash me." The eyes were wild now, but the gun did not waver in the big hands.

"No, it's no trick. I'm sorry, but you're no more Vandersen than I am. The *real* Vandersen was killed eighteen months ago on the Arctic front. He lives on in tape form in your processing units, and in the hundreds of dupes manufactured each year. Vandersen, the most formidable, resourceful and versatile fighter of the war, the only man who can come up with a different answer every time."

The room was suddenly silent. Slowly and carefully Stonebanks lit a cigarette, and then lobbed the packet and the lighter to Vandersen, who caught them onehanded.

Vandersen sucked on the cigarette, and exhaled tiredly. "I don't believe you," he said.

"I know," replied Stonebanks, "you can't." There was a lot more he could have told his prisoner turned captor, but the words had dried up in his throat.

He could have told him that not only was Vandersen's personality printed on his mind; he was conditioned to believe he was Vandersen. He could tell him that erasure of the Vandersen print would leave him a blank, characterless amnesiac who would have to relearn everything from how to read and write to handling eating utensils, a helpless creature.

How could he tell a man, who thought he was a national hero, that in fact he was a mindless pawn, one of many anonymous thousands used by both sides in this miserable war, who had no more identity or volition than the factory-built robotrooper?

"Put the gun down," he said finally. "If you don't, you'll be cut down the second you leave this room. Those are the guards' orders, whatever the circumstances. Besides, I have something to show you."

The commandant, the remaining conscious guard, and the man who thought he was Vandersen, walked together from the room.

Blinking their eyes at the bright sunlight, they emerged into a large compound, ringed by barbed wire and high watchtowers. Five hundred prisoners were standing in rank formation.

The commandant stepped onto a platform and clicked on the microphone. "Attention men. When called, the following will take one pace forward. Vandersen—!"

All five hundred stepped forward. ■

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If it takes a thief to catch one—
then this scheme ought to work just fine!

F. PAUL WILSON

ILLUSTRATED BY VINCENT DI FATE

RATMAN

Since its purpose was neither to load nor unload cargo, his converted tramp freighter was directed to a landing pad at the far end of the field where it wouldn't get in the way. Orz, red-haired and of average height and build, though somewhat stoop-shouldered, didn't mind. As long as he was in the general area his efficiency would be unimpaired.

When the viewscreen picked up an approaching ground car, Orz snapped his fingers and a half-kilo space rat leaped from the control console to his shoulder.

"Let's go, 62," he said to his favorite employee.

The space rat grasped the fabric of his master's shirt tightly in his tiny paws and lashed his tail about nervously. He didn't like meeting strangers, but it was part of his job; his master had found that there was a definite psychological advantage in appearing with a space rat on his shoulder.

Orz and 62 reached the hatch just as the ground car pulled up alongside. They scrutinized the two occupants as the freighter's loading ramp descended.

The first to debark was a portly little man wearing a stylish orange tunic that should have been two sizes larger. His companion probably weighed as much but was taller and better proportioned.

Orz's long legs carried him swiftly down the ramp after it had settled and the portly one came forward to meet him.

"Mr. Samuel Orzechowski?" he asked, mangling the pronunciation.

Orz smiled. "That's right, but you can call me Sam, or Orz, or, as some people prefer, Ratman." *And being a client,* he thought, *you'll no doubt choose the last one.*

"Well," the little man replied, "I guess 'Ratman' will do. I'm Aaron Lesno, president of the Traders League and this is Evan Rabb, our treasurer," he said, indicating the man beside him.

"Welcome to Neeka," said Orz.

"Could I ask you something, Ratman?" Rabb hastily interjected. He couldn't take his eyes off 62. "Is that a space rat?"

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"A small one," Orz nodded. "A baby, really."

"Aren't you afraid of . . ."

"Of losing my ear?" he grinned. "Not at all. I imagine you two and the rest of the League are somewhat in the dark as to my methods, and you've probably got a lot of questions. I've found it best in the past to get everyone together and explain things to everybody at once. It saves me time and you money."

"An excellent idea!" Lesno agreed. "We've all been anxiously awaiting your arrival . . . well," he corrected himself with a glance at Rabb, "almost all . . . but I'm sure there would be no problem in getting everyone together."

"What did you mean by 'almost all'?" Orz asked.

Rabb spoke up. "One of our more influential members was vehemently opposed to the idea of retaining you."

"Oh, really? Why?"

"Have no fear, Ratman," Lesno assured him with a smile, "he'll let you know why at the meeting tonight."

"That's fair enough," Orz said. "Now can someone come back and pick me up in a few hours for the meeting?"

"Why not come with us now and let us show you around a bit?" Lesno offered.

Orz shook his head and gestured over his shoulder to the ship. "Sorry . . . feeding time."

Rabb and Lesno stiffened and glanced nervously from 62 to the open hatch. "Yes, quite," Lesno muttered. "Very well, then, we'll have someone call for you in, say, three hours."

"That'll be fine." This settled, the two-man welcoming committee lost little time in putting some distance between themselves and the squat little freighter.

"Seems like pretty decent fellows," Orz told 62 as he made his way up the ramp and down the central corridor. As they approached the rat room, 62 began to prance excitedly on his master's shoulder and was literally doing a dance by the time Orz hit the door release.

His several hundred fellow employees inside took up the same excited dance at the sound of the door sliding open. The cages were arranged five high along the walls of the long, narrow room. They were simple, steel-sided boxes with front doors of quarter-inch steel mesh; each was self-cleaning, had its own water supply and was equipped with an automatic feeder.

But Orz had never trusted automatic feeders, so now he went from cage to cage and shoved food pellets through the tiny feeding hole in the front of each. He had to be nimble for the rats were greedy and anxious and a fingertip could easily be mistaken for a pellet. His practiced eye decided how much each rat should get. This was important: a rat became fat and lazy if overfed and

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would gnaw his way out of the cage if underfed. A rat in either condition was of little use to Ratman.

Fifty cages stood open and empty and Orz placed a few pellets in each; 62 was frantic by now so he decided to give the little fellow something before he jumped off his shoulder and into one of the empty cages. The rat rose up on his hind legs, snatched the pellet from Orz's proffering fingers with his tiny, handlike paws and began to gnaw noisily and voraciously.

Three hours later, Orz flipped a particular switch on the console, checked to make sure the door to the rat room was open, then headed for the hatch. There, after casting an eye through the dusk at the approaching ground car, he secured the hatch, but opened a small panel at its bottom. With 62 perched watchfully upon his shoulder, he was waiting at the bottom of the ramp when the car arrived.

Lesno was alone inside. "Well, Ratman," he said with a smile, "everybody's waiting, so—" then he spotted 62 and his face fell. "Does he have to come along? I mean, he won't get too excited, will he?"

"Don't worry," Orz replied, sliding into his seat, "he won't bite you." To lessen the man's anxiety he made a point of keeping 62 on his far shoulder.

"Your advertising literature was quite timely," Lesno remarked as they got under way, hoping conversation would take his mind off those two beady eyes peering at him around the back of his passenger's head. "The rat problem was reaching its peak when we received it. I trust that wasn't just coincidence."

"No coincidence at all. I keep my ear to the ground and word got around that there was a space rat plague on Neeka. I figured you could use my services."

Lesno nodded. "We had heard a few stories about you but didn't know whether to believe them or not. Your advertising claims were quite impressive. I just hope you can live up to them."

About twenty exporters and importers were waiting in the conference room on the second floor of the Traders League office complex. It was a motley group of discordant colors, shapes, sizes and ages. Lesno entered ahead of Orz and lost no time in bringing the meeting to order.

"We all know why we're here," he said, tapping the gavel twice, "so there's really no use in wasting time with introductions." He pointed to Orz. "The creature on this man's shoulder is introduction enough. Ratman has arrived and he's going to tell us something about himself and about space rats." So saying, he relinquished the podium.

Nothing like a businesslike business, Orz thought as he stood up and received a slight spattering of applause. They knew of his claim to be

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able to control space rats with space rats and were frankly dubious. But this was nothing new to Orz.

Without even a glance at the audience, he nonchalantly snapped his fingers and tapped the top of the podium; 62 immediately leaped from his shoulder to the podium and began to sniff the wood curiously.

"This," he began, "although a specimen of *Rattus interstellus*, is not a true 'space rat' in the full sense of the word; but his parents were. Lab-raised space rats—such as 62, here—can turn out to be quite friendly, but they are no less cunning, no less intelligent and certainly no less vicious when cornered. These are the rats I 'employ,' so to speak.

"But first let's puncture a few of the myths that have grown up around the space rat. First of all, no matter what the spacers tell you, space rats have no psi powers; they don't know what you're going to do next . . . it's just that their reflexes are developed to such a high degree that it almost seems that way when you take pot shots at one with a blaster. They will respond to ultra-frequency tones but by no means do they have a language . . . they're intelligent, all right, but they're a long way from a language."

His eyes flicked over the audience. These were traders, barterers; they recognized a man who knew what he was talking about, and they were all listening intently.

He continued. "But just what is it that distinguishes the space rat from other rats?" To dramatize his point, he allowed 62 to crawl onto the back of his hand and then held the fidgety creature aloft.

"This is the product of centuries in the pressurized but unshielded holds of interstellar cargo ships. Wild genetic mutation and the law of survival of the fittest combined to produce a most adaptable, ferocious and intelligent creature.

"Everyone knew of the space rat's existence, but no one paid much attention to him until an ensign aboard the freighter *Clinton* was kept awake one night by the continuous opening and closing of the compartment door outside his cabin. The ship was in port, and, under normal circumstances, he would have spent the night in town, but, for one reason or another, he had returned to his quarters.

"Now, these doors which divide the corridors into compartments open automatically when you touch the release panel and remain open as long as a simple electric eye beam is broken; when the beam makes contact again, the door closes. The doors naturally make some noise when they operate, and this is what was disturbing the ensign. But, everytime he checked to see who was wandering up and down the corridor, he found no one. Checking with the guard detail he found that he was the only person authorized to be in that area of the ship.

"So he set up watch. Opening his door a crack, he peeked through to

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the corridor and waited. But no one came and he was about to give up when he spotted this large space rat come running down the corridor. As it approached the door it leaped over a meter into the air and threw itself against the release panel. The door slid open as the creature landed on the floor and it scurried through before the door closed again."

The traders were smiling and shaking their heads in wonder as Orz paused and placed 62 back on the podium. "Since it is doubtful that the rat could have accidentally leaped against the release panel, it must be assumed that he learned by watching. That would make him a highly unusual rat . . . they thought. Then they discovered that the whole colony aboard the *Clinton* knew how to operate the doors! Then other spacers on other ships began watching for space rats while their ships were in port—that's when their movements are the greatest; they stick pretty much to the cargo holds in transit—and it was discovered that the *Clinton* rats were not so extraordinary. These reports fired the interest of researchers who figured they would go out and catch themselves a few space rats and put them through some tests."

The audience broke into laughter at this point. They were all quite familiar with the elusiveness of the space rat.

"Another characteristic of the space rat was soon discovered: viciousness. It took quite a while, but, after much effort and many scars, a number of space rats were caught. And, as expected, they proved virtually untrainable. We hoped to do better with their offspring.

"I was working with the offspring when I heard about a rat problem in the nearby spaceport. Traps, poison, even variable frequency sonic repellers had failed to control them. I went to investigate and found that a good many space rats were jumping ship and setting up residence in the warehouses which ring every spaceport. Another factor was added: In the warehouses they meet other strains of space rat from other ships and the resultant cross-breeding produces a strain more intelligent and more ferocious than even the cargo-ship rat. I managed to catch half a dozen in as many months, mated them and began to go to work on the offspring. Through a mixture of imprinting and operant conditioning, second generation space rats proved quite tractable.

"But I needed more wild rats and tried the wild idea of training my lab rats to help catch other rats. It worked out so well that I decided to go into the business of space-rat control."

He paused and glanced around the room. "Any questions?"

An elderly trader in the front row raised a bony hand. "Just how does one rat go about catching another?" he asked in a raspy voice.

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"I'll demonstrate that tomorrow," Orz replied. "It'll be easier to understand once you see the equipment."

A huge, balding man with a grizzled beard stood up without waiting to be recognized. "I've got a question, Ratman," he said belligerently. "If all you've got are a few trained rats, why do you charge so much?"

This elicited a few concurring mutters from other members of the audience. Here, no doubt, was the man Lesno had referred to earlier that day.

"You have me at a disadvantage, sir," Orz replied with a smile.

"I'm Malcomb Houghton and I guess I rank third, or fourth, around here in cubic feet of warehouse space."

Orz nodded. "Very glad to meet you, sir. But let me answer your question with another question: Do you have any idea what it costs to operate a privately owned freighter, even a small one such as mine? My overhead is staggering."

Being a businessman, this argument seemed to make sense to Houghton, but he remained standing. "I just wonder," he began slowly, "if you can train rats to catch other rats, how do we know you didn't land some special trouble-making rats here on Neeka a few months ago to aggravate the situation to the point where we had to call you in?"

The audience went silent and waited for Ratman's reply. Orz cursed as he felt his face flushing. This man was dangerously close to the truth. He hesitated, then cracked a grin.

"How'd you like to go into partnership with me?" he quipped.

The tension suddenly vanished as the audience laughed and applauded. Orz gathered up 62 and left the podium before Houghton could zero in on him again. He couldn't tell whether the man was stabbing in the dark, or whether he really knew something.

Lesno escorted him out the door. "Wonderful!" he beamed. "I think you're the man to solve our problems. But time is of the essence! The port residents have been on our necks for months; their pets are being killed, they're afraid for their children and they're afraid for themselves. And since the rats are based in the warehouse district, we might be held liable if we don't do something soon. And"—he put his hand on Orz's shoulder and lowered his voice—"we've been keeping it quiet, but a man went after a few of the rats with a blaster the other night. They turned on him and chewed him up pretty badly."

"I'll start as early as possible," Orz assured him. "You just send somebody around tomorrow with a good-sized truck and I'll be waiting."

Rabb must have overheard them as he approached. "That won't be necessary," he said. "We're placing a truck at your disposal immediately. I'll drive it over to your ship and

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Lesno will bring me back after dropping you off."

Orz said that would be fine and he arranged a time and place of meeting with Lesno for early the next morning on the way back to the ship. A few minutes later he and 62 were standing next to the borrowed truck watching the two League officers drive away.

"Ratman!" whispered a voice from the deep shadows under the ramp.

Orz spun around. "Who's there?" he asked guardedly.

"I'm your contact."

"You'd better come out and identify yourself," he said.

Muttering and brushing off the knees of her coveralls, a tall, statuesque brunette stepped out of the shadows. "Where have you been for the past hour? We were supposed to meet as soon as it was dark!"

"Just who are you, Miss?" Orz asked.

She straightened up and stared at him. "You don't take any chances, do you?" she said as a wry smile played around her lips. "O.K. I'm Jessica Maffey, Federation agent NE97. I'm the one who received a smuggled shipment of fifty of your best harassing rats, drove them into town and let them go in the warehouse district. Satisfied, Ratman?"

Orz grinned at her annoyance. "You're Maffey, all right . . . I've got a picture of you inside, but you can't be too careful." He glanced around. "Let's get inside where we can talk."

"Speaking of going inside," she said, "there's been a steady stream of rats going through that little opening in the hatch."

He nodded. "Good. I activated a high-frequency call before I left. All the harassers you loosed should be snug in their cages by now."

He unlocked the hatch and led her to the rat room. As he busied himself with transferring 62 to a cage and checking on the harassing rats, Jessica looked around. From the darkened recess of each cage shone two gleaming points of light, and all those several hundred points of light seemed to be fixed upon her.

"Three missing," Orz was saying. "That's not too bad . . . accidents do happen." He pressed a button on the wall and the open doors on the cages of the harassing rats swung shut with a loud and simultaneous clang.

"How about a drink?" he offered his guest.

"As a matter of fact, I'd love one!" she replied, sighing with relief as they stepped back into the corridor. Orz looked at her curiously. "It gets a little dry and dusty sitting under a loading ramp," she explained with a tight smile.

With Jessica seated in his spartan, fastidiously neat living quarters with her hand around a cold gin and tonic, Orz began to talk business. "Federation Intelligence only gave me a sketchy idea of what's going on here. You were to fill me in on the

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rest, so why don't I tell you what I know and you take it from there."

"Go ahead," she told him.

Drink in hand, Orz paced the room as he spoke. "Let's start with this planet. Neeka is a fiercely independent, sparsely populated world which exports a lot of food and imports a lot of hardware. Formerly a splinter world, it agreed to trade with the Federation but refused to join it. They were asked to join the Restructurists in their revolt against the Federation but turned them down. They want absolutely no part of the war . . . and I can't say as I blame them.

"*However:* the Haas Warp gate is right outside this star system and the convoys stack up in this area before being shot through to the battle zones. Fed agents discovered a turncoat feeding information on the size and destinations of the convoys to someone on this planet. That someone, in turn, was transmitting the info to the Restructurists via subspace radio. He's been stopped temporarily, but as soon as he makes another contact, he'll be in business again. I was told to meet you here and stop him. That's all I know."

Jessica nodded and drained her drink. "Right. But subspace transmissions can't be traced so we had to depend on deductive reasoning. First of all, you're allowed to be pro-Federation, or pro-Restructurist on Neeka, and you're allowed to talk all you want about either cause. Nobody minds. But try to do something to aid either cause, and you wind up in prison. Strict neutrality is enforced to the letter on Neeka. Therefore, partisan natives, such as myself, and the man we're after have to go underground.

"Now, it would be as easy to smuggle in a subspace transmitter as it was to smuggle in your rats, but hiding it would be an entirely different matter. It's a huge piece of hardware and it needs a large power supply."

"So the man we're after," Orz broke in, "is someone with easy access to an off-planet source of information, and a place big enough to hide a subspace transmitter without arousing suspicion."

"And a warehouse right here in port has the size and access to the necessary power," Jessica concluded. "Since the members of the Traders League own all the warehouses, they are the obvious target for investigation."

"But which one?"

She shrugged. "Their security is too tight for me to do much snooping. The only way to get into those warehouses is to be invited in. That's where Ratman comes in."

Orz was thoughtful. "It really shouldn't be too difficult. I was informed by the Traders League when they retained me that their warehouses are fully automated and computer-operated."

"With a population density as low as Neeka's," Jessica added, "labor is anything but cheap."

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"Right," he continued. "And, if I wanted to hide a subspace radio in one of those warehouses, I'd disguise it as part of the automation works and no one would ever be the wiser. All I've got to do tomorrow, when I go into the warehouses, is keep my eyes open for an unusually large computer-automation rig. When I find it I'll just 'accidentally' expose it as a subspace transmitter. The Neekan authorities will take care of our spy after that."

He suddenly halted his pacing and snapped his fingers. "Forgot to turn off the call signal for the rats . . . I'll be right back."

"Mind if I come along?" Jessica asked.

"Not at all."

She watched Orz's back as he led her down the narrow corridor to the bridge. "Can I call you something other than 'Ratman?' "

He grinned over his shoulder. "Sam will do fine."

"O.K., Sam: how did you get started in all this?"

"Well, I got the idea a few years ago and thought I was a genius until I started looking for backers. Everyone I approached thought I was either a swindler, or a nut. As a last desperate hope I went to IBA."

"What's IBA?"

"Interstellar Business Advisers. It's a private company with some pretty canny people working for them. They dug up somebody who promised to back me halfway, then they approached the Federation with this undercover idea. Since I'd be able to get on otherwise unfriendly planets, the Federation put up the rest of the money. So now I'm a full-time Ratman and a part-time Fed man. And when my reputation spreads, IBA has got some ideas for starting a corporation and selling franchises."

They entered the bridge as he was speaking and Jessica noticed that it was as meticulously ordered as his quarters. Two additions to the standard console caught her eye immediately.

"Improvements?" she asked, pointing to a brace of toggle switches.

Orz flipped one of the toggles to "off" and turned to her. "Those are the high-frequency signals for my rats. They've got an effective range of about two kilometers and when a rat hears the proper tone, he makes a beeline for this ship."

"And what's that?" She indicated a bright red lever with three safety catches and "Danger" written in white letters along its length.

The lightness left his voice. "For the direst of emergencies only," he replied.

Feminine curiosity aroused, Jessica went to touch it. "What does it do?"

"That's my secret," Orz replied with a tight smile and snatched her wrist away from the lever. "I've yet to use it and I hope the day never comes when I do." To draw her attention elsewhere he pointed to the

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far wall. "See that inconspicuous little switch over there by the intercom speaker? When that's in the down position—like now—the controls are locked."

"You're just full of tricks, aren't you?" she said, trying to hide a smile. He was like a little boy showing off a new toy.

"Can't be too careful."

Lesno, Rabb, Houghton and a few others were ready and waiting when Orz pulled up in front of the Traders League offices with the truck.

"Straight ahead," said Lesno as he hopped in beside Orz. "We'll start with Rabb's places first since they're the closest." Two left turns brought them up before a huge structure with a "Rabb & Co." sign above the sliding doors. Orz waited until the others had arrived, then addressed the group.

"First of all," he told them, "you must keep all humans away from any warehouse where my rats are at work, so give whatever employees you have the day off. Next, let me explain that space rats set up a close-knit community within a warehouse—one community per warehouse—and that each community has a leader who achieved his position by being the most cunning and the most ferocious in the community."

He reached into the back of the truck and brought out a simple cage. Inside was a very large and very vicious-looking space rat. "This is one of my Judas rats. I've selectively bred them for ferocity and any one of these is a match for any three ordinary space rats. Within hours after his release, my Judas rat will have established himself at the top of the community's pecking order."

Once again Orz reached into the back of the truck and brought out a cage, but this one was larger and empty. "Normally a space rat wouldn't go near a trap like this, but he'll follow the Judas if the Judas is the community leader. And once the community has followed him inside and is busy at the bait, the Judas hops outside, releases this catch and a spring closes and locks the door. He then returns to the ship. The cage is made of a lightweight titanium alloy that not even a space rat's teeth can dent." He held up the cage. "Tomorrow morning this should be filled with a community of very angry space rats."

"Is that all there is to it?" Houghton blurted incredulously. Orz could imagine the man's mind tallying and totaling, and deciding that no matter what his overhead, Ratman charged too much. "This is outrageous! I'll have nothing to do with such nonsense! We're being hoodwinked!"

Somebody doesn't want me in his warehouse, Orz thought and was about to say something when Rabb beat him to it.

"The League has already retained Ratman, Malcomb, and we voted to use the treasury to do so . . . remember? So you have, in effect, already paid for his services, and it

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would be foolish of you not to take advantage of them."

Houghton paused, considering Rabb's words, then he glanced at the cage and shrugged. "I guess I don't have much choice," he said sullenly and turned toward his car. "Let me know when you get to my places."

It was late in the day when they finally did get around to Houghton's warehouses, but Orz had preferred it that way. He had his suspicions and wanted to see as many of the other warehouses as possible before confronting Houghton. There had been nothing suspect in the others, although Lesno's computer setups had been somewhat larger than most, but nowhere near big enough to house a subspace radio.

Houghton met them outside.

"I've only got a few cages left," Orz told him, "so we'll do as many as we can and I'll get the rest tomorrow after I collect the cages I've set out today."

"Might as well start with the main house," Houghton replied and led them toward the largest building of his complex. The doors slid open to reveal a huge expanse of concrete floor with crates and boxes stacked almost to the ceiling. Huge cranes—controlled by a computer that knew the exact location of every item in storage—swung from above. Looming against the far wall was a large, metal-paneled structure.

Orz pointed to it. "Is that your computer?"

"Yes," the bearded man replied absently, "now let's get on with this . . . I haven't got all day."

"Mind if I take a look at it?" Orz asked and started walking toward it. This was what he had been looking for; it was big enough to house two subspace transmitters. "Rats love to nest in those things, you know."

"I assure you there are no rats in there so stay away from it!" Houghton almost shouted. He began to follow Orz and Lesno and Rabb trailed along.

Orz went to the nearest inspection plate and began loosening the screws which held it in place.

"Get away from there!" Houghton yelled as he came up. "You don't know what you're doing! You could mess up my whole operation!"

"Look, if I'm going to do my job right, I've got to check this out!" The inspection plate came off in his hands then and he stuck his head inside. Nothing unusual. He replaced it and went to the next plate with the same result. Four more inspection plates later he was sure there was no subspace transmitter hidden within.

Houghton was standing behind him and tugging angrily on his beard as Orz replaced the last screw. "Are you quite through, Ratman?"

Orz stood and faced him. "Awful big computer you've got there, Mr. Houghton," he said matter-of-factly. He was chagrined, but refused to show it.

"That's the computer for my whole operation. I found it easier to

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centralize the system: instead of installing new units all the time, I just add to the central unit and feed it into the new buildings as they are built. It's much more convenient."

"More economical, too, I'll bet," Orz added laconically.

"Why, yes. How did you know?"

"Lucky guess."

Jessica was waiting for him back at the ship. "Don't bother telling me you didn't find anything," she said as he collapsed in a chair, "that look on your face tells me the whole story."

"I was so sure it was Houghton! The way he objected to the League retaining me, the way he tried to rake me over the coals at the meeting last night, the way he blew up this morning, I was sure he had something to hide. Turns out he's only a cheapskate with a centralized computer."

"What makes you so sure he hasn't got it stashed somewhere else?" Jessica asked, coming over and handing him a drink.

He accepted it gratefully and took a long slow swallow before answering. "I'm not sure of anything right now. But, if that transmitter's here—and we know it is—it's got to be in one of those warehouses. Which reminds me . . ." He got to his feet slowly and trudged to the rat room.

Jessica didn't follow, but glanced out into the corridor when she heard the clang of cage doors. Furry gray and brown shapes were scurrying toward the hatch.

"What are you up to?" she asked as Orz reappeared.

"I had a brainstorm on my way back to the ship. We'll find out if it worked tomorrow."

Orz noticed Jessica in the crowd outside Rabb's main warehouse. She smiled and winked mischievously, knowing he couldn't acknowledge her. The crowd was waiting to see if Ratman could live up to his claims and watched intently as he and Rabb disappeared inside. An uncertain cheer began and died as he reappeared dragging—with little help from Rabb—a cageful of clawing, squealing, snarling, snapping space rats. Having retreated to what it considered a safer distance, the crowd applauded.

Lesno strode forward, beaming. "Well, Ratman, I knew you could do it! But what are you going to do with the little monsters now that you've caught them?"

"Most of them will have to be gassed and killed, but I'll save a few of the best for breeding purposes . . . I like to keep my working stock as strong as possible."

They completed the rounds of Rabb's buildings, then moved on to Lesno's. The novelty had worn off and the crowd was beginning to thin by the time they got around to Lesno's third warehouse, but interest was renewed at the sound of Orz's voice calling from within.

"Mr. Lesno! There's something you ought to see in here!"

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Lesno went in. Rabb, Houghton and some of the braver members of the crowd—Jessica among them—followed him in.

It looked as if a bomb had gone off inside. Every crate, every package had been torn open. Even some of the computer paneling had been torn away.

"What happened?" Lesno cried, staggered by the destruction.

Orz shrugged and pointed to the full cage. "I don't know. There's your community, caged and ready to go. But I've never seen anything like this before."

Houghton was looking over the ravaged computer. "Never seen a computer that looked like this," he muttered. "Is this some new model, Aaron?" he asked Lesno.

Rabb came up. "Looks like part of a subspace radio!"

"Ridiculous!" Lesno sputtered. "What would I be doing with—"

"You're a spy!" Houghton declared. "A Federation spy!"

A blaster suddenly appeared in Lesno's hand. "Don't insult me by linking me to the Federation!"

Houghton shrugged. "So you're a Restructurist spy, then. Just as bad. You get twenty years either way."

"I'm not going to argue with you, Malcomb. Just stay where you are."

"You can't escape, Aaron!" Rabb warned.

Lesno smiled. "Of course I can," he said and pointed the blaster at Orz. "Ratman is going to volunteer the use of his ship. He's even going to come along for the ride to make sure no one gets trigger-happy."

Orz caught Jessica's eye. She was readying to make a move. but he shook his head. They had succeeded in destroying Lesno's effectiveness as a spy. It didn't matter if he escaped. And so, with a blaster at the back of his head, Orz preceded the little man to the truck.

"You work for the Federation, don't you?" Lesno said as Orz drove them toward the spaceport.

"I'm afraid I don't have time to work for anyone other than Sam Orzechowski."

"Come now, Ratman. I was suspicious yesterday when I saw the way you gave Houghton's computer a going over and this morning's revelation confirmed my suspicions. Why deny it?"

Orz shrugged. "O.K., I occasionally do some snooping for the Federation."

"How did you get on to me?" Lesno asked earnestly. "I thought I had a foolproof arrangement."

"Well, I wasn't sure, but Houghton's centralized setup started me on a new approach. I figured that if one man could centralize his computers, another could *de*centralize a subspace transmitter. Then it struck me that you'd have to take the transmitter apart in order to sneak it into town. And since it was already in pieces, why not leave it that way? At least that's what I would have done. So the next thing to do was to look

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for the man with the *slightly* larger computers. You fit the bill."

"But how did you manage to tear the place apart?"

"That was easy. If you could go back to that warehouse now, you'd find a tiny, high-frequency *labeler* attached to the door. I have a number of vandal rats trained to be specialists in making a mess out of a building. The *labeler* told them where to go to work."

Shaking his head in admiration, Lesno remarked, "You should be working for us."

"But I don't want a Restructured Federation," Orz replied. "I sort of like it the way it is."

"But there are such inequalities in the galaxy! Some planets are drowning in their surpluses while other planets are starving, and the Federation does nothing!"

"The Federation doesn't think such matters are within its scope."

"They will be when we win!" Lesno replied righteously.

Orz knew argument was futile and allowed a shrug to be his only reply.

Once on the ship, it was evident to Orz that Lesno knew his way around freighters. He retracted the ramp, secured the hatch and then followed Orz to the bridge.

He gestured to the extra seat. "You just sit there and keep out of the way, Mr. Ratman, and you won't get hurt. I'm not a murderer. If all goes well, I'll drop you off at the first neutral port we reach. But I won't hesitate to shoot you if you try anything."

"Don't worry," Orz told him. "My mission was to stop you, not capture you. I really don't care if you get away."

Lesno's eyes narrowed. This lack of chauvinism did not fit his conception of a Fed man. Something was up. His suspicions were reinforced when he found the console inoperable.

"Where's the lock?" he demanded.

Orz pointed across the room. "By the speaker." But Lesno made no move. Instead his eyes roved the room until they came to rest on the red lever. His face creased into a smile.

"You didn't think anyone would be fooled by that, did you?"

Orz nearly leaped from his seat as the Restructurist reached for the lever. "Don't touch that!"

"Sit down!" Lesno warned, pointing the gun at Orz's chest. "I told you before, I'm not a killer but—"

"I know you're not!" Orz said frantically. "Neither am I. That's why you've got to leave that lever alone!"

Lesno merely smiled and kept him covered while he released the first two safety catches. "Listen to me, Lesno! That lever sets off a special tone stimulus and releases every one of my rats! They've all been trained to attack anyone and everyone but me when they hear that tone . . . I installed it for use in a situation when it was either kill or be killed!

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This is not one of those situations!"

Lesno was having some trouble with the third catch, but it finally yielded. "A good try, Ratman," he said and, ignoring Orz's cry of protest, pulled the lever.

Faintly, from far down the corridor, came a metallic clang. A loud, wailing tone filled the ship. Lesno paled and turned anxiously toward his captive.

"Why didn't you listen to me, you fool!" Orz yelled.

Lesno suddenly believed. Horror stricken, he began to push and pull the lever back and forth but with no effect. He was still working at it when the squealing, gray brown carpet swept through the door.

Orz turned away and tried unsuccessfully to block out the screams and sickening sounds of carnage that filled the bridge. He had trained the rats too well . . . there would be no stopping them.

And when all was quiet again, Orz congratulated himself on having kept his stomach in place. But then 62 leaped up to his accustomed spot on his shoulder and began with great contentment to clean his reddened claws and jowls.

Only Jessica came to see him off. Orz had cleaned up the rat problem and the people were appreciative, but they had either seen the corpse that had been removed from his ship, or they had heard about it.

"I see the red lever's been removed," Jessica remarked. She hadn't been near the ship since the incident.

Orz avoided her gaze. "Yeah. I took it out . . . can't quite look at it." He changed the subject abruptly. "Well, now that this thing's been cleared up, what'll you be doing with yourself?"

"I've no intention of settling down and becoming a good Neekan citizen, you can be sure of that!" she replied. "I'm putting in for an assignment as soon as possible. There's too much going on out there for me to get tucked away on this rock!"

Orz smiled for the first time in several days. "That's funny. I was thinking of taking on an assistant. This business is getting a little too complicated for me to handle alone."

He paused as Jessica waited eagerly.

"You like rats?" he asked. ■

The Analytical Laboratory / May 1971

PLACE	TITLE	AUTHOR	POINTS
1.	The Outposter (Pt. 1)	Gordon R. Dickson	1.94
2.	Company Planet	James H. Schmitz	2.64
3.	Peace With Honor	Jerry Pournelle	2.72
4.	Not Stupid Enough	G. H. Scithers	3.41
5.	Culture Shock	Perry A. Chapdelaine	3.70

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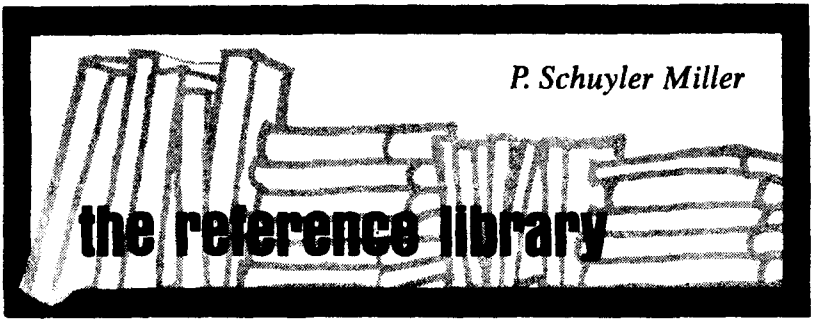

THE NEBULA AWARDS

There are two sets of annual awards in the science-fiction and fantasy field. The "Hugo" awards, named for Hugo Gernsback, are made by readers—members of the annual World Science Fiction Convention, held over the Labor Day week-end. (This year it will be in Boston: see the March issue for details.) The "Nebula" awards, on the other hand, are made every March by the Science Fiction Writers of America. (There may be a third set for non-English-language stories, when the European conventions get started.)

For the 1970 Nebula Award winners I am indebted to Charles and Dena Brown, editors and publishers of a usually-biweekly-but-frequently-weekly newsletter called *Locus,* which Charlie Brown has kept going for four years. It is handsomely mimeographed; it brings you news of magazines, writers, artists, conventions, books, fanzines—you name it!—while it is news, and you pay $3.00 for twelve issues or $6.00 for twenty-six, if you live in North America. If you are interested, the Browns are at 2078 Anthony Avenue, Bronx, N.Y. 10457.

For the first time, the Science Fiction Writers voted "No Award" in the short-story category. I haven't read any of the seven stories that got into the finals, so I'll say nothing more about them. I have read the winning novelette, Theodore Sturgeon's "Slow Sculpture," which was in *Galaxy* in February, 1970 and will be in a new collection of Sturgeon stories out soon. Though it has a certain amount of gadgetry, this is basically a story about people and what makes them tick. In passing, it deals with a subject on which John Campbell has editorialized—if there is no possible way out of your dilemma (in this case, as in his editorial, cancer), it is intelligent to try the impossible. Again, I haven't read the runners-up.

Best novella of the year was a sword-and-sorcery fantasy, "Ill Met in Lankhmar," by Fritz Leiber. This is one of his Grey Mouser series,

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which hold up as consistently the best in this increasingly popular field. At a time when the intellectual "ins" have no use for anything but antiheroes, heroics are making a comeback among the bourgeoisie.

The novels, though, I have read. Winner, as best SF novel of 1970, is Larry Niven's rather old-fashioned "Ringworld," a Ballantine original paperback for 95 cents. Niven won a Hugo for "Neutron Star," a "hard science" short story on a subject that is tying the astronomers and astrophysicists into knots. Both stories are part of a series set in a complex galactic future of many worlds and races, in which our galaxy is exploding. The world of the title is an extraordinary system whose planets have been combined into one colossal ribbon, a million miles wide, set in orbit around its star, with fields and forests, lakes and mountains, men and cities on its lighted inner surface. This is a variant on the so-called Dyson Sphere, proposed a few years ago as the ultimate creation of a tremendously old, tremendously powerful race that must capture and use all the energy of its sun. The ancient Builders of the Ringworld have not gone so far as to enclose their star in a sphere, but they have given themselves a vastly extended future—then disappeared. An oddly assorted crew of men and non-men is sent to investigate.

In a sense, Ace Books is a special winner-without-award, for four of the other five novels in the finals are Ace Science Fiction Specials, and any one of them could be a justifiable winner. Joanna Russ's "And Chaos Died" was tied for second place with the lone hardback original in the finals, Robert Silverberg's "Tower of Glass." Wilson Tucker's "Year of the Quiet Sun" came next, followed by R. A. Lafferty's "Fourth Mansions" and D. G. Compton's "The Steel Crocodile." "And Chaos Died" would have been my own choice of the six . . . an extraordinary conceptualization of a "lost" colony which has developed a convincing—and fascinating—psionic society. Tucker has made his return to science fiction with a grim time-travel story that projects our present relentlessly into the near future, Lafferty has a surrealistic yarn in his own inimitable manner about men and supermen. Compton's book is on the man-versus-computer theme. Silverberg's is a complex story about a society of men, near-men and androids in which tortured interrelationships have developed during the building of the gigantic tower which gives his book its name.

The same April 4th issue of *Locus* lists the Hugo nominees, on which members of the Boston convention will be voting as you read this. Analog has two candidates. Hal Clement's sequel to "Mission of Gravity," "Star Light," is a candidate for Best Novel, against the tough competition of "Ringworld," "Tower of Glass," "Year of the Quiet Sun," and Poul Anderson's novel about light-

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speed spaceflight, "Tau Zero." And "Brillo," by Ben Bova and Harlan Ellison, here last August, is one of five candidates for best short story. It's running against Nebula-winning "Slow Sculpture," which was rated a novelette in the Nebula voting.

Other Hugo candidates—you may be able to vote if you join the convention soon—are Dean Koontz's "Beastchild," Fritz Leiber's winning "Ill Met in Lankhmar," Harlan Ellison's "The Region Between," Clifford Simak's "The Thing in the Stone," and Bob Silverberg's "The World Outside," in the novella class, and Lafferty's "Continued on Next Rock," Keith Laumer's "In the Queue," Gordon Dickson's "Jean Dupres," and Sturgeon's "Slow Sculpture" as short stories. No predictions: the Sturgeon and Leiber stories are the only ones I've read yet.

In the Best Magazine category, Analog will be competing against *Amazing Stories, Fantasy & Science Fiction*, *Galaxy*, and the discontinued English magazine, *Vision of Tomorrow*, which few of the voting fans will have seen.

Charlie Brown ran a poll of his own, and announced the results in the same *Locus* with the Nebula winners and Hugo nominees. His readers made "Ringworld" a runaway winner, but they also made "Tower of Glass," "Year of the Quiet Sun," and "And Chaos Died" the runners-up, then matched "Fourth Mansions" with another Silverberg novel, "Downward to the Earth," for fifth place and added Anderson's "Tau Zero." Gordon Dickson's Analog serial, "Tactics of Mistake," rated a few points above "Starlight." "Brillo" stood eighth in the short fiction, and Analog took second place—to *F&SF*—among the magazines. As with the SFWA, *Locus* readers scattered their short fiction votes, but they did give a first to Ellison's "Region Between."

MACROSCOPE

By Piers Anthony • Avon Books, New York. • No. W-166. • 480 pp. • $1.25

Years ago the *Saturday Evening Post* had an article on making a country-style stew. You put a pot on the back of the stove, and threw into it anything edible that came your way. It was indescribable, it was unanalyzable—and it was delicious. So is "Macroscope."

Piers Anthony has put into his massive story large dollops of every kind of science fiction you can think of. He invents a new category of fundamental particles—the macrons—that can carry images across intergalactic distances with higher resolution than short-distance light. He adds a program of cosmic education—at least, information dissemination—with a mind-killing boobytrap embedded in it. He provides a "hero" who is the Mongoloid-Negroid-Caucasoid product of an experiment in mixed genetics and education, which has also spun off a superman whom everyone is

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trying to find, and who is setting traps for his hunters out of sheer malice. He adds an anti-heroine who is likely to drive the reader to strong drink before he is done with her. He outdoes anything "Doc" Smith, or Ed Hamilton, or John Campbell, ever tried in their most uninhibited days by converting the planet Neptune into an impossible faster-than-light self-propelled spaceship to circumnavigate the universe, or nearly. And he weaves astrology so tightly into the whole thing that you won't be able to pull the nonsense out of the sense without having everything fall apart.

You may have trouble getting into the thing, but once you're in, you'll find it just as tough to get out. So you'll sit there, reading and muttering, until they come and carry you away. They just let me out again.

MECHASM

By John T. Sladek • Ace Books, New York. • Special No. 71435. • 222 pp. • 75¢

From time to time—not often enough, in my book—some of the smaller theaters around town run a bill made up of glued-together bits from the old, old film comedies that our parents called "trashy." It does me a great deal of good to find that people—young people—still laugh at them. Critics assure me that they laugh for all the wrong reasons—reasons they should be ashamed of. Because the old comedies built, and built, and built until the whole thing blew up. They were logical when they were the most ridiculous. The audience could see the traps being set, the calamities taking shape, though the victims couldn't. In their—our—safe omniscience and infinite superiority, we watched the poor fools walk unaware into mayhem.

This doesn't happen in modern comedy; *it isn't supposed to.* The point of modern comedy is that there is no point—no logic in the world. We know that it is wrong to feel superior to some innocent idiot. We know that we are simply reinforcing our sadism and undoing all our analysts have spent months to do, when we laugh at such things.

"Mechasm"—called "The Reproductive System" in England, where it appeared two or three years ago, and where they thought it was hilarious (but you know English humor!)—is hopelessly old-fashioned. There's this company with the ridiculous name of Wompler Toy Company in a small—3,810 and shrinking—town somewhere in Utah. It's going broke, so it decides to get some of that government money that it keeping Utah, and Nevada, and everything west of the Atlantic coastline strong, healthy and productive. Its *modus operandi* is a machine to make more machines, including more like itself . . . and before you can say "Sorcerer's Apprentice" the world is waist deep in little gray boxes that make more little gray boxes that . . .

Camp. Corn. Classic.

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BRASS TACKS

"Dear Mr. Campbell:

In regard to your editorial "The New Stone Age" dealing with campus-crime you discuss the issue from the aspect of "student immunity," a valid point. The problem also involves a matter of student quality. With the exception of the "meaty sciences" far too many snap courses are being offered by colleges these days, allowing the student too much free time. Full-time students should qualify at twenty credit hours per quarter not twelve. Entrance standards should be raised and part-time student enrollment minimized. Statistics seem to indicate that students engaged in the "meaty-sciences," or with heavy course loads, seldom take active part in campus crime; they just don't have the time. It's time the colleges began to scholastically cull the bums from student rolls.

In dealing with campus riots neither the objective, nor the method of achieving it, seem entirely clear. Apparently the idea is to forcefully evacuate the area without causing fatalities. As practice has proved, sending in a small number of men bearing firearms and tear gas in an attempt to vacate a thousand or more people from a large area is unrealistic, at least when the use of firearms is taboo. The effectiveness of tear gas is limited at best, dependent yet on the vagaries of the wind. Firearms and bayonets are for producing fatalities or, at the very least, serious injury. Using a firearm as a bluff tactic eventually leads to someone calling that bluff and hence a Kent State Syndrome. Clearly the conventional equipment, man power, and mode of operation presently being employed by the police and militia invites serious or fatal casualties on the one extreme or relative noneffectiveness on the other. For a noncasualty mass evacuation formula using limited man power a new and unique arsenal of equipment is needed. Until such equipment is provided militia and police should operate with limited objectives, i.e., making limited arrests, protecting firemen, evacuating buildings, et cetera.

Calling in the police, or militia, usually signifies that force and violence will be required to deal with the situation. Force and violence by nature are brutal, otherwise the terms must be re-defined. That law enforcers must carry firearms is obvious since the danger of armed resistance is always present. With some ingenuity and imagination directed toward the development of new equipment a noncasualty evacuation objective is feasible, at least in relative terms. For example, highly mobile armored fire trucks delivering under pressure and at suitable range a water-base, oil-base, or sticky-base chemical solution with highly obnoxious, but relatively innocuous, qualities is a possibility, i.e., concentrated

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"rectal essences" of skatole, indole, or mercaptan type compounds, or some equally foul material. Electric stock prods—hot-shots—fashioned for double use as billy clubs would make effective close-order crowd movers as well as self-defense weapons. I don't claim to be a weapons expert and only propose these ideas to provoke thought in defense of my argument. If we can get to the Moon, we can certainly disperse a mob; strictly small potatoes with the right kind of equipment. Sure, there will be screams of BRUTALITY!, but force and violence are by nature brutal and after all, that's the name of the game.

Under the present mode of operation it would require at least matching the number of demonstrators with an equal number of troops since the situation essentially boils down to a hand-to-hand encounter. Since this is impractical, law enforcers must rely on the effectiveness of their equipment to augment their lack in man power. Clearly tear gas and rifle brandishing tactics are not the answer. Rioting is not new to society. The American noncasualty approach to handling riots is however, and will require new tactics. The only other alternative is to revert to the "Clear out or we start shooting!" method, effective, but necessarily deadly.

F. B. MAXSON

Rt. 2, Box 13-A
Rapid City, S. Dak. 57701

I am largely in agreement with you—but a small number of highly trained and highly disciplined police can disperse a large number of rioters nonlethally with present weapons such as the police baton. That depends on the great efficiency of men in a disciplined group over an undisciplined mob. There is much howling of "Brutality!" however—because the essential and violently hated fact is that that method works.

The basic rule here is "Any method that works is loathsome, inhuman, brutal, vicious because it defeats our intention to force compliance to our will!" Under that overriding consideration, such available methods as covering the mob with a harmless, nontoxic, noninjurious, nonirritant and nonstaining foam, is violently rejected. (Demonstrated at parks or beaches, children love to play in a five-foot-deep, thirty-foot-across mass of the foam!) The foam stops a mob, because each individual suddenly finds himself optically and acoustically—it muffles sounds very powerfully—from all others; the mob is broken up instantly not by geometrical separation, but by communicative separation.

It's a new technique; it's effective. That automatically makes it doubly loathsome—and it isn't used.

Dear John:

During the last few months here in Vietnam, we have been made aware of a new and remarkably successful chemical-warfare tactic being employed against United States troops.

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These last six months I have been working officially and unofficially within the Army's program, such as it is, for rehabilitation of heroin and barbiturate addicts. I won't speculate on the casual, once- or twice-a-month-use rate, but the percentage of persons *known* to be *physically addicted* to heroin in some units in this area is as high as thirty-five per cent.

For as low as $1.50 a man at this base can purchase, from any of a large number of "friendly, helpful Local Nationals," a plastic vial one half inch in diameter, and slightly less than an inch in length, filled completely with a white crystalline powder. I have been told that lab analysis has shown about two to six percent by weight of various impurities. The remainder is heroin with traces of unconverted opium derivatives. Some of the persons we have treated have been introducing the contents of six of these vials into their bloodstreams per day. A person in the United States would have little chance of developing a habit on this scale—he would long since have died of quinine poisoning, embolism, or starvation—this in addition to the obvious logistical problem of obtaining $175 per day, or more.

I have been told, by sources not known for unusual reliability, that the Chinese, who used to channel a

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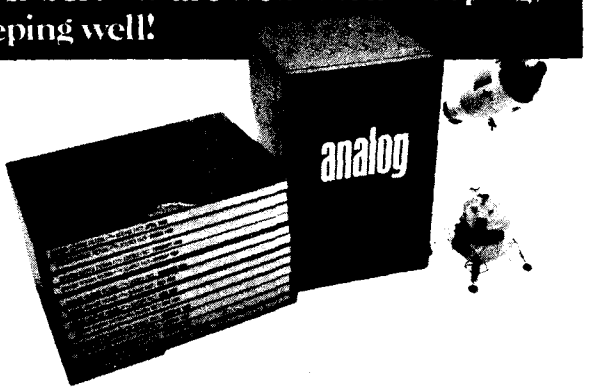

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fairly good-sized amount of narcotics States-ward through Singapore, Hong Kong, and other ports, have diverted most of the traffic to South Vietnam, and are forsaking monetary gain in favor of immediate effect, namely the disruption of military activities here, and the intensification of disorder in the United States as the men who have become addicted are returned to the States by normal rotation. Whether or not this is the intent, this is the effect.

To my untrained eye, most of the addicts we treat are between four and seven years old, emotionally.

One of the primary reasons given by them for their beginning drug use is boredom.

Only a very few of the addicts interviewed said that they had not watched television a great deal from their early childhood. These were generally from low-income homes.

Two persons interviewed who did not use drugs of any kind, including alcohol, stated that they had either not had a television available in early childhood, or were not allowed to watch it more than a few hours per week. Both came from families which stressed family recreation and individual initiative in entertainment: reading, hobbies, et cetera.

If something isn't done about this, in less than no time . . .

I am twenty-four, a former heavy drug user—I never "graduated" to heroin, but that was a simple matter of availability—and now happily married to a medical records technician.

MICHAEL RATHBUN

This raises an interesting question of international law: What constitutes "biological" or "biochemical" warfare? Heroin is a lethal substance; the fact that fools voluntarily take the stuff does not alter that fact. The deaths due to heroin addiction in New York City one weekend exceeded the number of military deaths in Vietnam during that time—and while the young people are deeply, and sometimes violently, concerned about the war, drug use constitutes "doing their thing" apparently, and so no opposition appears.

The heroin sold in the United States has usually been "cut" with some other substance. Since heroin tastes bitter, the older technique of cutting with milk sugar, which tastes sweet, has been abandoned; now it's being cut with interesting things like quinine and other alkaloid drugs which are cheaply available, and also taste bitter.

As Stewart Alsop pointed out in Newsweek, *heroin addiction is the proximate cause of most of the violent crime that is killing our cities.*

Mr. Rathbun states the vials are about one half inch in diameter by a little less than an inch long; since the Chinese, like most of the world, use the metric system, I imagine they are actually 1 cm. in diameter by 2 cms. long. This quantity of pure-heroin-equivalent would cost about $75 to $100 in our cities.

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FINAL BLACKOUT

continued from page 7

No process as vast and violent as a supernova explosion can be perfectly symmetrical, homogeneous or smooth; the resultant neutron star is spinning, but normally the magnetic field doesn't wind up trapped *exactly* along the axis of rotation of the star. And the magnetic field will not be exactly uniform, like a lecture-room diagram. And the distribution of mass won't be *exactly* uniform . . . .

And the neutron star is not quite the end of the line; there is still further evolution to be undergone.

For one thing, that magnetic field reaches out for millions of miles, and keeps stirring up the still-cooling gases of the outer mantle of the original star. It generates light and radio energies in the process, and accelerates the ions of those gases to cosmic-ray relativistic velocities. While no electromagnetic structure can exceed the speed of light, a beam of magnetic force reaching out from a spinning star must, at some distance, be sweeping at 99.9999999+% the speed of light, and be accelerating ions to *very* relativistic speeds.

But this work and momentum must necessarily be derived at the expense of the spinning neutron star. The ions of the outer gases are accelerated, and the neutron star is gradually slowed in doing so.

Even with the horrendous surface gravity of a neutron star, if something fifteen miles in diameter is spinning at three hundred times a second, it will *not* be a perfect sphere; it's going to be an oblate spheroid, with an equatorial bulge.

When it slows its spin somewhat, the shape of the star will readjust, of course—and it's going to do it despite the super-super-super straitjacket of that crust 10^{20} times as strong as steel! Not even that super-solid crystalline material can stand up to the sort of gravity forces at the surface of a neutron star.

The fascinating thing is that the results of such neutron "star-quakes" have been observed by astronomers! Not as structural changes seen by telescopes, of course—but because when there is a star-quake, and a resultant redistribution of mass—on a very minute and gentle scale, that's what happened to Los Angeles last spring; the San Gabriel mountains rose some four feet—there's a change in the distribution of angular momentum, and consequently a change in the rate of spin of the star. Since neutron star pulsars send out their pulses with exceedingly high precision, any minute change in the rate of spin can be detected and measured.

A star-quake in which the crust yields as little as one thousandth of a centimeter is readily detectable; that crystalline crust stuff has an appallingly high density remember, and it's out at the outermost periphery of the star. Just a minute shift represents movement of a mass equal to

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half a dozen Earths, perhaps. (And the energy released, if you put it on a hypothetical extension of the Richter scale, would probably be something like 100. The Richter scale goes only to 10—because much greater energy than that released here on Earth wouldn't leave anybody around to talk about it.)

So . . . we have the neutron stars, which we detect as pulsars. And we have evidence that old pulsars have much lower rates of spin. That is, pulsars are still evolving—that isn't a stable end to the evolution of a giant star.

It's also known that some stars are not merely five or ten times as massive as the Sun—some of them appear to be sixty to eighty times as massive. Such stars are, of course, immensely luminous; they burn their nuclear fuel as much as 100,000 times as fast as Sol, and they're strictly dedicated to a short life but a merry one. The probable lifetime of such a star is well under 500,000 years.

All calculations indicate that when it finally goes into collapse—it can't stop at the neutron-star stage. The implosion of the burnt-out core, when it comes, will be so violent, the temperatures so extreme, and the inward pressures of gravity plus the implosion effect between infalling core and the outward-blasting overlayers such that the core material will be driven beyond the neutron-star stage.

All the protons will be crushed out of existence—and even the neutrons begin to lose identity. And things happen to the resultant gravitational field.

Compressed beyond even the maximum density of nuclear matter, beyond even the density of neutrons themselves, the gravitational forces do weird things.

The surface gravity becomes so high that the escape velocity required for a particle to escape the gravity field may rise to, say, 200,000 miles per second. I.e., if you wanted to fire a particle from the surface of the *collapsar,* so that it could drive out against its immense gravitational field and escape into space, it would have to be launched with a velocity of 200,000 miles per second.

Since a photon is energy, and therefore mass, and cannot travel faster than 186,000 miles per second—not even a quantum of radiant energy could escape such a surface!

Of course, if you were already in orbit around such a collapsar, and didn't have to fight your way out from the surface itself, you could get free with less velocity. That is, there is a zone at some distance from the collapsar itself at which you could establish an orbit with an orbital speed of a mere 186,000 miles a second.

Anything venturing inside that zone would be absolutely trapped. Nothing whatever can come out from within that zone; the collapsar exists at the bottom of a gravitational

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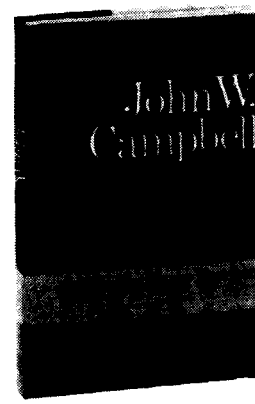

well so deep that *nothing* can escape once it gets in there.

This zone is, of course, extremely esoteric; the things happening at that level in the gravity well can only be expressed in relativistic terms—and as one major scientist said, it amounts to a genuine science-fiction space-time warp! Relativity involves recognition that space dimensions and time have a true metrical relationship; at that strange surface, known for the man who first explored it mathematically as a Schwartzchild Discontinuity, the time dimension tends to replace one of the space dimensions in an exceedingly complex way. A ship that tried to reach the collapsar could not exceed the speed of light—yet it would be accelerated under a stupendous gravity force all the way in. Oddly, with a finite distance to go, it would, theoretically, take a near-infinite time to reach the star! The time-expansion effects would be exceedingly complex!

If a man somehow got his spaceship inside the Schwartzchild Discontinuity around a collapsar, he could never report back as to what he saw, and, of course, could never return. And he wouldn't get very far, anyway, due to tidal effects.

On Earth if you go ten feet up, there is a minute change in the gravitational force acting on you. Gravitometers have been made which are sufficiently sensitive to measure such a difference in the acceleration of

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gravity due to a ten-foot difference in elevation. Since gravitational force varies with the inverse square of the distance, you're heavier on the ground than on the upper floors of a building—even if it does take super laboratory instruments to detect it!

The gravity field around a collapsar is something else again. At any given level, say a mile from the surface, the absolute value of the field is appalling—hundreds or thousands of millions of Gs. And the value will have dropped to a quarter of that stupendous value if you go another mile or so; the *rate* of decline is even more fantastic than the value itself.

But it's the difference between gravitational acceleration at one end of an object, and the acceleration value at the farther end that produces tidal forces.

The tidal forces around a collapsar are of such magnitude that *the nuclei of atoms will be disrupted by tidal forces.*

If you lowered a rod through a Schwartzchild Discontinuity into a collapsar's field, not only would it be impossible to pull it out—no information can travel outward through a Schwartzchild Discontinuity—but the outer end of the rod would be stretched apart and broken mechanically by the tidal forces, while the inner end of the rod's matter was undergoing nuclear dissolution.

Since *no* information can escape from a Schwartzchild Discontinuity, it is impossible to see one, detect it by radar, X rays or any other probing technique. Not even its magnetic field can escape!

It is totally cut off from the Universe—save in one respect. That gravitational field that is the operating agency of collapsars will still be present and to be accounted for!

Naturally, since we now have an invisible black ghost to consider—the Black Hole Star—a lot of long-time puzzles of astronomy and astrophysics are up for review in the non-light of this new possibility.

One puzzle that's cropped up repeatedly is the mystery of the star Epsilon Aurigae B.

Epsilon Aurigae is a binary; the A, or brighter star, is a supergiant FO-type of very high luminosity 60,000 times our sun—it's a massive (and, therefore, brilliant and short-lived) star with a companion. They make an eclipsing pair—i.e., the 27 year binary orbit plane is such that Earth happens to be almost exactly in that plane, and we see A and B pass in front of each other.

The light-curve of the eclipse is, however, *most* peculiar. When the B star eclipses its brilliant companion, the decline of light-level indicates we're seeing A *through* star B—that B is mostly transparent.

Which might be acceptable if it weren't that the orbits indicate that star B is itself enormously massive, many times more massive than our Sun.

Assorted explanations have been tried; some years back it made head-

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lines as the largest star known because they tried explaining that light curve on the basis that the B star was a super-super-*super*-swollen Red Giant type about two billion miles in diameter, and of such low temperature we practically didn't see it at all against the glare of its huge, brilliant companion.

More recently that's gone out of acceptance for assorted reasons based on further data; for a while it was explained as a more ordinary massive star, with a vast tail of matter that was being exuded along its orbital path. Sort of a diamond ring effect—a ring of gas-dust with the "jewel" being the B star itself.

One trouble was that no one's caught the spectrum of the B star itself well enough to be able to say anything about its nature.

So, naturally—they're now considering that the B star is a collapsar, a black hole, while the queer eclipse pattern is caused by some of the debris of the supernova explosion that produced the collapsar. The debris of gas and dust remains trapped by the gravitational fields of the A and B stars—but naturally, you can't see the B star itself—you couldn't if you were right there in orbit around the pair.

Of course the A star managed to survive the catastrophic demise of its companion—but it won't for long. Stars that big and brilliant have short life spans; presently it, too, will detonate and collapse into a Schwartzchild Discontinuity, leaving nothing but some gas-dust debris orbiting behind two black holes, a practically totally invisible black ghost binary.

The cosmologists like this idea for their own reasons; current theories are in trouble because the curvature of space derived from astronomical measurements does *not* match what their theories maintain it should be for the quantity of mass observed. There should be many times more mass than has ever been detected to produce the observed characteristics of space.

Black holes could account for the missing mass—it's here all right, but unobservable.

And it does not all have to be in such weird systems as two black holes orbiting each other; there's an entirely different type of black hole that does not involve such extreme conditions as the collapsar. That is the Black Galaxy—the entire galaxy that constitutes a Schwartzchild Discontinuity, but does *not* have to involve collapsar conditions.

The essence of the black hole effect is that *nothing* can escape its gravitational field—that even a quantum of light will be dragged back by the gravitational field, because the escape velocity exceeds 186,000 miles per second. The collapsar achieves that effect by fantastic density resulting in a stupendous surface gravity—by immense concentration of gravitational force.

Now you can stop a bullet with a quarter inch of exceedingly strong, dense, and hard armor plate—but

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you can stop it just as thoroughly with a bale of cotton, too. The cotton is neither hard, dense, nor exceedingly strong—but it clings and enwraps and slows the bullet. It doesn't even distort the bullet—but it stops it just as completely as the armor plate could.

The gravitational field of a galaxy isn't very intense of course—but it extends out and out over distances you don't measure in miles, but in kiloparsecs. It's not violently intense, but it persists over vast distances, light-year after light-year taking its toll of anything seeking to escape.

It can be shown mathematically that a dense galaxy—and that means a quite livable density, not star-touching-star type of thing, less dense actually than some of the known star clusters!—may have a gravitational field so strong and so extensive that no ray of light, no radio wave, not even an X or cosmic ray, can ever leave it—nor could any spaceship subject to the normal laws of relativity. Assuming a continuing operation of a drive mechanism capable of developing thrust greater than the force of the galactic gravity, it would appear that such a ship could, at least theoretically, climb out of that Schwartzchild black hole. Sorry—no dice. The total amount of energy required is necessarily greater than $E = mc^2$ allows. Even if 100% of the mass of the ship were converted to driving energy, it wouldn't be sufficient to climb out of the gravitational well.

A Black Galaxy would achieve, by the long, long slope of a gravitational field reaching out megaparsecs what a collapsar's field achieves by immense concentration of force.

Both would be absolutely inescapable.

But the Black Galaxy would be a weird place to visit! Just what would happen to a ship falling into such a Black Galaxy calls for some really fancy analysis! Coming in from outside, it would *not* encounter the vicious tidal forces that can disrupt nuclei, because the Black Galaxy field isn't anywhere intense—just extensive. But since the escape velocity of the field exceeds the speed of light, anything coming into that field would be accelerated to . . . well, what speed? Could it be accelerated in, at parabolic or hyperbolic velocity, and shoot out the other side, having acquired energy of fall sufficient to achieve an escape, even though that escape requires faster-than-light speed? If not, what happens to the excess energy?

Of course inside the Black Galaxy could be stars with planets and intelligent races who observed the starry heavens around them. What would they see of the universe outside? What happens to radiation falling into a gravity field with that greater-than-*c* escape velocity?

Once in a while the serious cosmologists come up with concepts and ideas that no science-fictioneer has been bold enough to dream up!

The Editor.

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